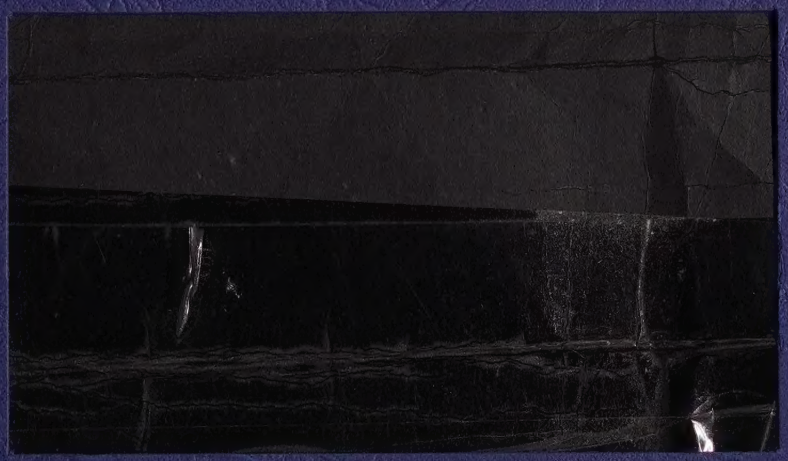
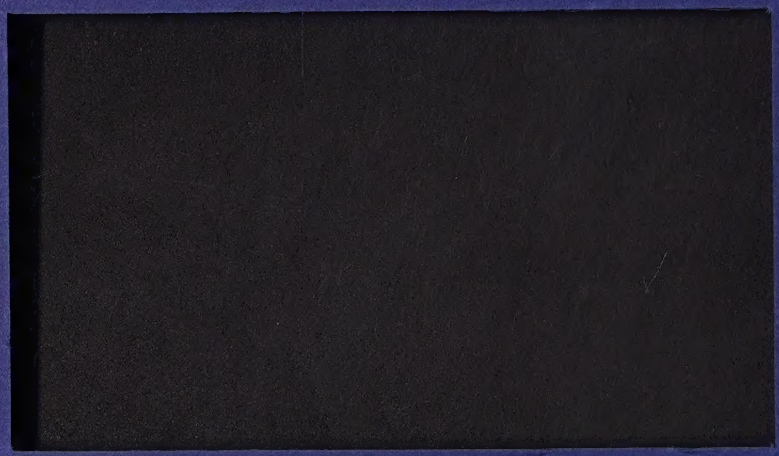


MP MASTER
MA23860

REDIFON
TELECOMMUNICATIONS
...on land and sea



HANDBOOK No. 1026-1
M.D.O'H/MWP/July 1977

REDIFON

Technical Information

INSTRUCTION MANUAL

for

MRT12 SERIES OF
MOBILE VHF RADIOTELEPHONES
(MRT12LB, MB & HB)

Redifon Telecommunications
Limited © 1977

Redifon Telecommunications Limited, London SW.18., England

PRINTED IN ENGLAND

A Member Company of the Rediffusion Organisation

SAFETY FIRST

The operation of electronic equipment involves the use of voltages which may be sufficiently high to endanger human life. Although every practicable safety precaution has been incorporated in this equipment the following rules should be observed:—

The power should be removed completely and any high voltage capacitors in power supplies discharged manually with a shorting bar before changing valves or making internal adjustments.

Under no circumstances should any person reach within a unit for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

Under no circumstances should interlock switches be removed, short circuited or tampered with in any way by other than authorised maintenance personnel; nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_11135

WARNING—SEMICONDUCTOR HAZARDS
TOXIC EFFECTS OF BERYLLIUM OXIDE (BERYLLIA)

Electronic components containing Beryllium Oxide are a serious hazard to health unless very carefully handled. The components are:—

Power Transistors, particularly VHF types, e.g. 2N3375, 2N3553, 2N3632, 2N5070, and equivalents.
Power Diodes, Thyristors.
Ceramic material, identified by blue colouration or black lines.
Heat Sink Washers, identified in the finished state by a high polish and dark brass appearance.

Handling Precautions

The components should not be carried loose, which can cause breakages and dust, or broken open for inspection or manipulation. Normal soldering is safe, but excessive heat must be avoided.

Heat sink washers must not be carried loose, abraded by tooling, or heated other than when clamped in a heat sink application. Handle with gloves, cloth or tweezers when removing from equipment.

Cathode Ray Tubes of some makes are coated on the inside with a ceramic Beryllium Oxide mixture. If the glass is broken do not touch with bare fingers or disturb the dust by blowing.

Health Hazards

Beryllium Oxide is highly dangerous in a dust form: if inhaled, poisoning, indicated by respiratory troubles or Cyanosis (grey-blue discolouration of the skin) may develop within a week, or after a latent period extending to several years. Particles penetrating the skin through wounds or abrasions are liable to cause chronic ulcerations.

Disposal Instructions

In view of the health hazard, scrap components must not be thrown out with industrial or domestic waste. Advice should be sought from the local Authority.

Medical Precautions

If Beryllia is believed to be on, or to have entered the skin through cuts or abrasions, the area should be thoroughly washed and treated by normal first – aid methods followed by subsequent medical inspection.

Suspected inhalation should be treated as soon as possible by a Doctor — preferably at a hospital.

REDIFON
TELECOMMUNICATIONS LTD

Contractors to:

British Broadcasting Corporation, Crown Agents, The Post Office, Ministry of Technology, Ministry of Defence.

Factories

HEAD OFFICE, SALES, SERVICE & SPARES

Broomhill Road, Wandsworth SW18 4JQ.
Telephone: (01) 874 7281
Telegrams & Cables: Redifon London Telex
Telex: 928229 and 264029

THE GARDEN FACTORY

Avondale Way, Cwmbran, Gwent.
Telephone: (06333) 67781
Telex: 497765

Development Laboratories

SUSSEX

Crompton Way, Crawley, Sussex.
Telephone: (0293) 25461

LONDON

Hardwicks Way, Wandsworth, SW18 4JQ.
Telephone: (01) 874 7281
Telegrams & Cables: Redifon London Telex
Telex: 928229 and 264029

Regional Marine Sales/Service Depots

LONDON OFFICE

Refer To:
Broomhill Road, Wandsworth SW18 4JQ.
Telephone: (01) 874 7281

ABERDEEN

180 Market Street, Aberdeen AB1 2PQ.
Telephone: (0224) 52465 or 571986

CWMBRAN

Marine Depot
Avondale Way, Cwmbran, Gwent.
Telephone: (06333) 67781
Telex: 497765

FLEETWOOD

Wyre Dock, Fleetwood FY7 6PJ.
Telephone: (039-17) 3747

FRASERBURGH

Sunnyneuek, Deer Road, Maud, Peterhead, Aberdeenshire
AB4 8NE.
Telephone: MAUD 262

GRIMSBY

North Quay, Fish Docks, Grimsby, Lincs DN31 3SY.
Telephone: (0472) 56947 or 58342
Telegrams & Cables: Redifon Grimsby

HULL

Wassand Street, Hull, Yorks.
Telephone: (0482) 26714
Telegrams & Cables: Redifon Hull

LIVERPOOL

6 Allerton Road, Liverpool 18.
Telephone: (051) 733 2818

LONDON DOCKS

3 Tilbury Gardens, Tilbury, Essex.
Telephone: (03752) 6271 or 6331

NEWCASTLE-UPON-TYNE

32 Howard Street, North Shields, Tyne and Wear.
Telephone: (08945) 78792 or 81792

SOUTHAMPTON

25 Queen's Terrace, Southampton SO1 1BQ.
Telephone: (0703) 26573

Redifon Project Engineers are available for consultation on complete communications systems

REDIFON TELECOMMUNICATIONS LIMITED LONDON SW18 4JQ ENGLAND

Telephone: (01) 874 7281 (15 *lines*)
Telex: 264029

Telegrams & Cables: Redifon London Telex
Marine Matters Please Telex: 928229

General Addendum
November 1976

SWITCH CLEANING FLUIDS

Proprietary Switch Cleaning Fluids often contain solvents capable of dissolving the plastic used in switch parts and of absorption by paxolin switch shafts. Either effect can result in permanent damage to the switch.

The indiscriminate use of these fluids, especially in aerosol form, is not recommended. If fault conditions indicate that switch cleaning is necessary single drops must be accurately placed where appropriate.

CONTENTS

1 BRIEF DESCRIPTION AND SPECIFICATION

2 INSTALLATION AND SETTING UP

3 OPERATING INSTRUCTIONS

4 CIRCUIT DESCRIPTION

5 MAINTENANCE AND REPAIR

6 FAULTFINDING AND REALIGNMENT

7 COMMISSIONING NEW CHANNEL(S)

8 ILLUSTRATIONS AND COMPONENT LISTS

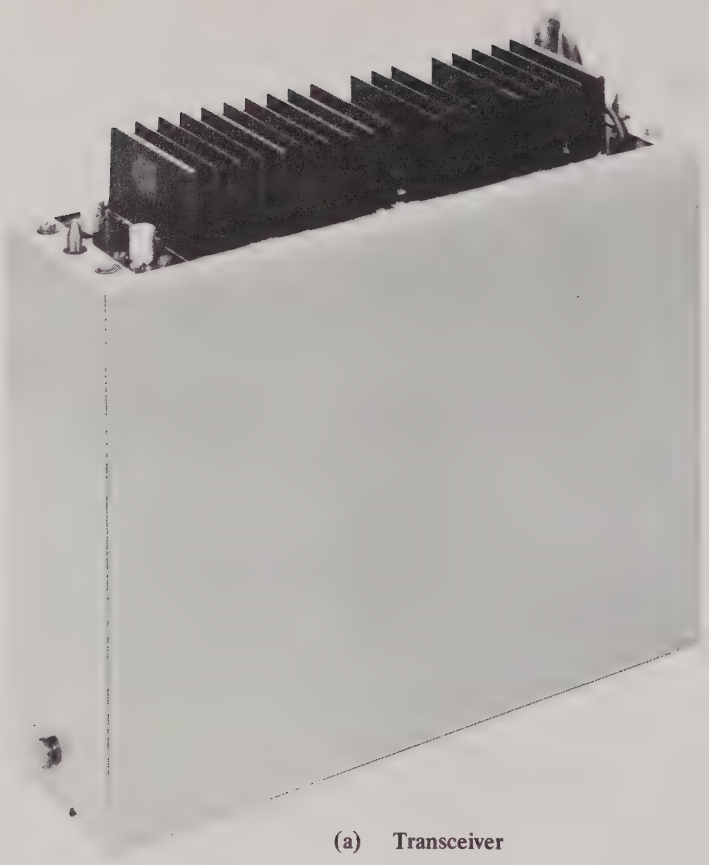
1 BRIEF DESCRIPTION AND SPECIFICATION

PLATE 1.1 UNITS COMPRISING THE REDIFON MRT12 RADIOTELEPHONE

1.1 BRIEF DESCRIPTION

1.2 SPECIFICATION
- 1.2.1 General
- 1.2.2 Transmitter
- 1.2.3 Receiver

Table 1.1 Summary of Specification Variations



(a) Transceiver

(b) Control Unit

(c) Loudspeaker

UNITS COMPRISING THE REDIFON MRT12 RADIOTELEPHONE

1 BRIEF DESCRIPTION AND SPECIFICATION

1.1 BRIEF DESCRIPTION

The Redifon MRT12 series of mobile radiotelephones are solid state frequency modulated equipments operating in the VHF bands. By means of a number of options, the customer is able to specify an equipment which fulfils his exact requirements. The equipments are intended primarily for land mobile use, but some versions may also be suitable for certain marine applications.

Versions are available which operate in the VHF low band (68–88MHz), the mid band (transmit 105–108MHz, receive 138–141MHz) or the high band (144–174MHz). These versions are designated MRT12LB, MRT12MB and MRT12HB respectively.

MRT12 radiotelephones are available in single channel, 4 channel or 12 channel versions. Minimum channel spacing may be either 25kHz (equipments designed to Home Office Specification W6346) or 12·5kHz (equipments fully type approved to Home Office Specification W6771).

Frequency control is by means of channel crystals (2 per channel) which are normally fitted to customer order. These may be changed or added to at any time, provided that the transmit and receive frequencies of new channels lie within 1% of the transmit and receive frequencies already fitted to the equipment.

Single antenna simplex working is normally employed, but a two antenna version is also available. Transmitter power output is greater than 13W. A transmit timer is incorporated, which may be linked in or out as required. When connected in circuit, this timer overrides the press-to-talk (PTT) switch after approximately 2 minutes; the timer is automatically reset on release of the PTT switch. The receiver delivers up to 2W audio output into an external 3Ω loudspeaker.

Each equipment comprises the three main units illustrated in Plate 1.1 opposite. The transmitter/receiver (or transceiver) (a) contains all the main circuits in modular form. This unit is controlled from the extended control unit (b), interconnections being made by means of a 4m (13 ft) long multicore cable with plug and socket connections. The third unit is the external loudspeaker (c), which is connected to the control unit by means of a 1·3m (4 ft) long flying lead.

Power supply and antenna connections are made at the transceiver. This unit has no user controls and may therefore be mounted in any convenient position (usually boot mounted).

Controls on the standard cab-mounted control unit comprise an on/off switch, a 12 position channel switch and variable squelch and volume controls; SUPPLY ON and Tx ON indications are provided. A fist microphone with integral PTT switch is connected to the control unit by means of a captive cable. Optionally, the control unit may be supplied with snap connectors for alternative microphone and PTT switch connections.

All units are of robust construction and are splash-proof. Reliability is assured by the use of silicon transistors and integrated circuits throughout. When necessary, the units can be easily removed from their mounting frames to gain access for servicing.

The equipments operate from the nominal 24V or 12V vehicle battery. 24V versions are fitted with an internal DC-DC converter which stabilises the supply at 13·8V (equivalent to a fully charged 12V battery); 12V versions operate direct from the unstabilised 12V battery voltage. The vehicle supply may be positive earthed, negative earthed or fully floating. Protection is provided against damage to the equipment should the supply polarity be accidentally reversed.

1.2 SPECIFICATION

1.2.1 General

Frequency coverage

Low band MRT12LB
- Transmitter, Receiver } 68–88MHz

Mid band MRT12MB
- Transmitter 105–108MHz
- Receiver 138–141MHz

High band MRT12HB
- Transmitter, Receiver } 144–174MHz

Number of channels

1, 4 or 12 channels

All transmit frequencies must lie within 1% of each other

All receive frequencies must lie within 1% of each other.

Minimum channel spacing

12·5kHz or 25kHz

Modulation

Frequency modulation (F3)

Maximum deviation ±2·5kHz (12·5kHz channel spacing versions)
or ±5kHz (25kHz channel spacing versions).

Mode of operation

Single antenna simplex or 2 antenna simplex

Antenna impedance

50Ω unbalanced

Supply voltage

24V versions: nominal 24V DC
- Minimum voltage 18V
- Maximum voltage 30V
- Within specification between 20–30V

12V versions: nominal 12V DC
- Minimum voltage 11V
- Maximum voltage 16V
- Within specification at 13·8V.

Supply currents (typical)

24V versions: at 27·6V input

Transmit	2A
Receive	0·2A

12V versions: at 13·8V input

Transmit	4A
Receive	0·4A

Supply earthing

Positive earth, negative earth or fully floating supply may be used.

Protection

Reverse polarity and over-voltage protection on supply input.

Supply input lines fused at 3A (24V versions) or 5A (12V versions).

PTT timer (2 minutes nominal) on transmit: can be linked in or out.

Current limit protection of the DC-DC converter (24V versions) with automatic shut-down if the receive current is exceeded in absence of the PTT signal.

Duty cycle

Continuous

Climatic standard

-10 °C to +40 °C splashproof

Humidity 90% at +40 °C

Dimensions (including mounting frames)

Transceiver

Height	254mm (10in)
Width	305mm (12in)
Depth	95mm (3¾in)

Extended control unit

Height	95mm (3¾in)
Width	162mm (6⅜in)
Depth	95mm (3¾in)

Loudspeaker

Height	95mm (3¾in)
Width	162mm (6⅜in)
Depth	60mm (2⅜in)

Weights (including mounting frames)

Transceiver	5·25kg (11 lb 9 oz)
Extended control unit	1·9kg (4 lb 2 oz)
Loudspeaker	425g (15 oz)
Fist microphone	185g (6½ oz)

1.2.2 Transmitter

Power output

Greater than 13W

AF input impedance

300Ω nominal

Modulation sensitivity

0·5mV pd at 1kHz gives two-thirds of maximum deviation.

Modulation response

Within +1dB -3dB of a 6dB/octave pre-emphasis characteristic from 300Hz to 2·7kHz.

1.2.3 Receiver

Sensitivity

Input signal of 1μV emf with two-thirds of maximum deviation at 1kHz gives a SINAD ratio better than 12dB.

Intermediate frequency

10·7MHz

Modulation response

Within +2dB -8dB of a 6dB/octave de-emphasis characteristic from 300Hz to 2·7kHz.

Audio output

2W into external 3Ω loudspeaker, with less than 5% total harmonic distortion at 1kHz.

Squelch

Noise operated variable squelch provided

Minimum opening level less than 0·7μV emf.

Table 1.1 Summary of Specification Variations

	MRT12LB		*MRT12MB*			*MRT12HB*								
*Identification code letter**	*V*	*W*	*C*	*D*	*E*	*J*	*K*	*L*	*M*	*N*	*P*	*Q*	*R*	*S*
Low band	X	X												
Mid band			X	X	X									
High band						X	X	X	X	X	X	X	X	X
1 channel						X								
4 channels							X		X		X		X	
12 channels	X	X	X	X	X			X		X		X		X
12·5kHz channel spacing (±2·5kHz maximum deviation)	X		X	X	X	X	X	X	X	X				
25kHz channel spacing (±5kHz maximum deviation)		X									X	X	X	X
Single antenna working	X	X		X	X	X	X	X	X	X	X	X	X	X
Two antenna working			X											
24V operation			X	X					X	X			X	X
12V operation	X	X			X	X	X	X			X	X		

* Equipment code is 001/11481 followed by identification letter.

Example of use of above table

Consider MRT12MB with identification letter D (equipment code 001/11481D). This is a mid band, 12 channel equipment with 12·5kHz minimum channel spacing (±2·5kHz maximum deviation), intended for single antenna working, and operating from a 24V supply.

2 INSTALLATION AND SETTING UP

FIG.2.1 TYPICAL MRT12 INSTALLATION

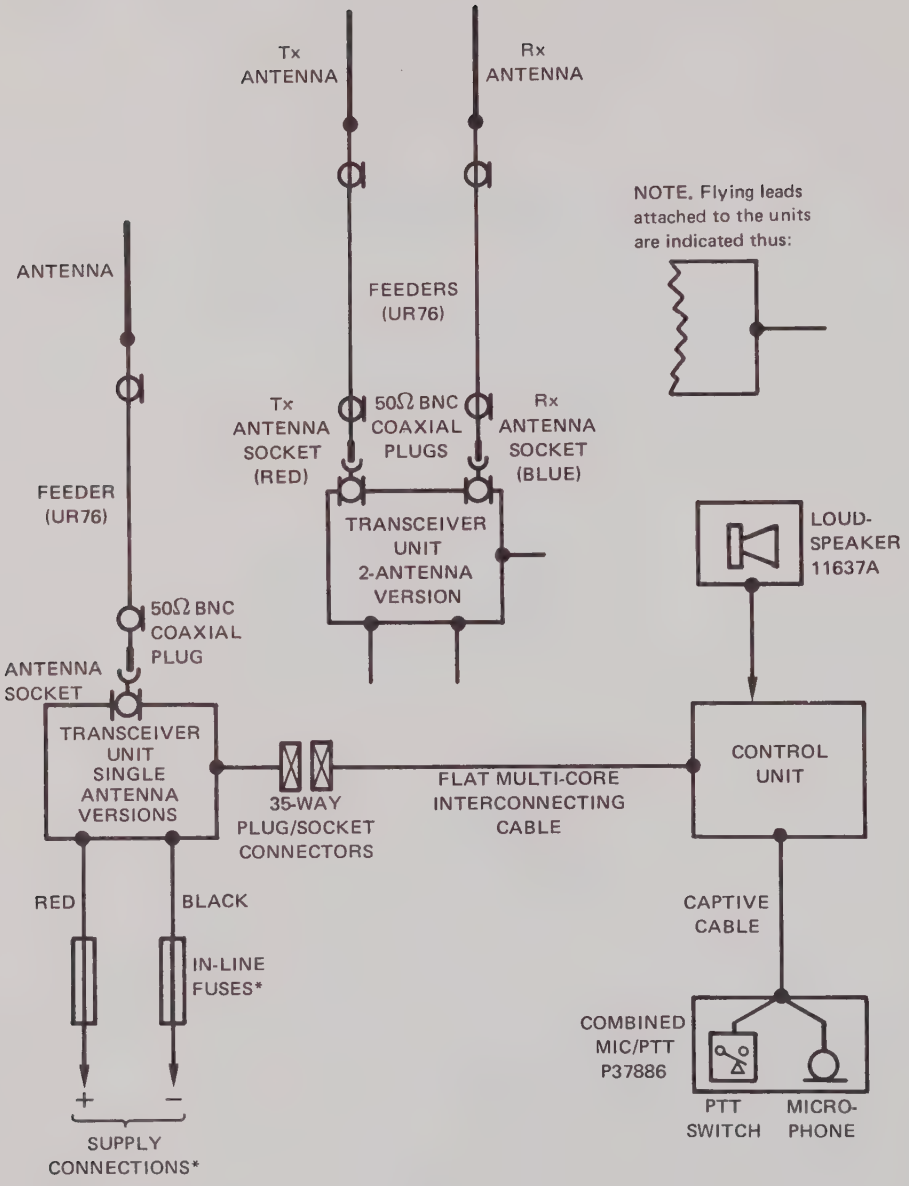
2.1 EQUIPMENT MOUNTING

2.2 ANTENNA MOUNTING

2.3 CONNECTIONS
- 2.3.1 Supply Connection
- 2.3.2 Antenna Connection(s)
  - Fig. 2.2 BNC Coaxial Plug Details
- 2.3.3 Microphone/PTT Connections
- 2.3.4 Loudspeaker Connection
- 2.3.5 Transceiver/Control Unit Interconnections
  - Table 2.1 Plug/Socket Connections

2.4 SETTING UP
- 2.4.1 Channelling
- 2.4.2 Timer Link
- 2.4.3 Modifying 24V Equipment for 12V

2.5 INTERFERENCE SUPPRESSION



*24V versions (18-30V DC input) fused at 3A
12V versions (11-16V DC input) fused at 5A

TYPICAL MRT12 INSTALLATION

FIG.2.1

2 INSTALLATION AND SETTING UP

2.1 EQUIPMENT MOUNTING

The three main units comprising the MRT12 radiotelephone are mounted separately in the most convenient locations. The transceiver unit, having no user controls, is usually boot mounted; the extended control unit and loudspeaker are installed in the cab. The control unit with its associated microphone/PTT switch must, of course, be mounted within easy reach of the driver/operator. The loudspeaker may be mounted in any convenient position in the cab, within the limits of the flying lead length (connects to the control unit).

Remove the units from their mounting frames (as applicable) and secure the frames in the desired positions. Allow sufficient clearance for opening the catches on the transceiver or removing the pivot bolts on the control unit, so that the units may be easily removed for servicing.

2.2 ANTENNA MOUNTING

The most common types of antenna for single antenna working are the plain quarter-wave whip and the colinear. The quarter-wave whip measures between 900mm (3 ft) and 400mm (16 in) in length, depending on the frequency band. Colinear antennae, which are available with either 3dB or 6dB gain, incorporate a loading coil and are slightly longer than the corresponding whip.

Mounting instructions are supplied with the antenna, and these should be followed carefully for best results. The antenna may be roof or wing mounted. Central roof mounting is to be preferred, however, since this provides a better earth plane; wing mounting gives distortion of the polar diagram, with less radiation in the direction of the "edge" of the vehicle. A junction box is provided at the base of the antenna for connection of the coaxial antenna feeder cable (down-lead).

Special "low profile" dual antenna systems are also available, and these may be used if required. A typical version has an overall diameter of approx. 600 mm (2 ft) and projects only about 75mm (3 in) above the roof of the vehicle. For use with a two antenna equipment, separate transmitter and receiver down-leads are necessary. Alternatively, the two antennae may be combined and a single down-lead employed for use with a single antenna equipment (full instructions supplied with the antenna).

2.3 CONNECTIONS

A block diagram of a typical MRT12 installation is shown in Fig. 2.1 opposite. Connection details are given in sections 2.3.1 to 2.3.5 below.

2.3.1 Supply Connection

Before connecting the supply, check that the vehicle battery voltage (24V or 12V) is correct for the transceiver. Supply voltage requirements for the various models of transceiver available are listed in Table 1.1. The supply may be positive earthed, negative earthed or fully floating.

If necessary, a 24V equipment may be modified to operate from 12V; for details refer to para. 2.4.3.

Supply connections are made to the in-line fuseholders (red lead positive). Check that the correct fuses are fitted, i.e. Belling Lee cartridge type L1055 rated at 3A fast blow for 24V operation, or 5A fast blow for 12V. Fuse dimensions are 32mm x 6·3mm (1¼ in x ¼ in). *CAUTION.* These fuse ratings must not be exceeded.

2.3.2 Antenna Connection(s)

The antenna down-lead(s) should be routed such that it/they will not be susceptible to damage. When using a single whip or colinear antenna, the down-lead (coaxial cable type UR76) is connected to the junction box at the base of the antenna—for details see antenna instruction sheet. At the transceiver, the lead is terminated in a 50Ω BNC coaxial plug which connects to the transceiver antenna socket. Assembly instructions for BNC plug type GE35070C10 (Greenpar) are given in Fig. 2.2.

A two antenna MRT12 installation may employ either two whips (or colinear antennae) or a "low profile" dual antenna system. Two separate coaxial down-leads must be provided. At the transceiver, the "receive" down-lead connects to the Rx antenna socket (colour coded blue), while the "transmit" down-lead connects to the Tx antenna socket (red). 50Ω BNC coaxial plugs are used in each case—see Fig. 2.2.

2.3.3 Microphone/PTT Connections

The extended control unit is normally supplied with a combined fist microphone/PTT switch (to Redifon drg. P37886) already connected to the control unit by means of a captive cable.

Optionally, however, short flying leads may be provided, with 2-pin snap connectors. In this case, terminate the microphone lead with a 2-pin AMP socket type 151680/2, using female connectors type 163557-2 (2 off) and connect to the blue coded 2-pin plug. Similarly, terminate the lead from the PTT switch with a 2-pin AMP plug type 151679/6, using male connectors type 163558-2 (2 off) and connect to the red coded 2-pin socket.

Table 2.1 Plug/Socket Connections

Core colour at control unit		*Plug/socket pin no.*	*Core colour(s) at transceiver*		*Function*
Group	*Colour*				
1	Black (BK)	1	Red/blue	(R/B)	1 } Select operating channel*
1	Red (R)	2	Green/red	(G/R)	2
1	Yellow (Y)	3	Yellow/red	(Y/R)	3
1	Blue (B)	4	White/red	(W/R)	4
1	Slate (S)	5	Red/black	(R/BK)	5
2	Black (BK)	6	Red/brown	(R/BN)	6
2	Red (R)	7	Yellow/blue	(Y/B)	7
2	Yellow (Y)	8	White/blue	(W/B)	8
1	Brown (BN)	9	Blue/black	(B/BK)	9
1	Orange (O)	10	Orange/blue	(O/B)	10
1	Green (G)	11	Yellow/green	(Y/G)	11
1	Violet (V)	12	White/green	(W/G)	12
1	White (W)	13	Orange/green	(O/G)	Spare
2	Brown (BN)	14	Red	(R)	+13·8V
2	Orange (O)	15	Black	(BK)	0V
3	Slate (S)	16	Green	(G)	High } microphone
3	White (W)	17	Blue	(B)	Low }
4	Black (BK)	18	Brown	(BN)	Press-to-talk (PTT)
4	Brown (BN)	19	Orange	(O)	Volume
4	Orange (O)	20	Slate	(S)	Squelch
3	Yellow (Y)	21	Pink	(P)	Connected in parallel to loudspeaker (high)
3	Green (G)	22	Violet	(V)	
3	Blue (B)	23	Green/blue	(G/B)	
3	Violet (V)	24	Slate/blue	(S/B)	
4	Green (G)	25	Green/black	(G/BK)	Spare
4	Violet (V)	26	Yellow	(Y)	Spare
3	Black (BK)	27	White	(W)	Connected in parallel to loudspeaker (low)
3	Brown (BN)	28	Slate/green	(S/G)	
3	Red (R)	29	Yellow/brown	(Y/BN)	
3	Orange (O)	30	White/brown	(W/BN)	
4	White (W)	31	Brown/black	(BN/BK)	On/off live (to switch)
4	Red (R)	32	Slate/brown	(S/BN)	On/off (from switch)
4	Yellow (Y)	33	Yellow/violet	(Y/V)	Spare
4	Blue (B)	34	Violet/black	(V/BK)	Spare
4	Slate (S)	35	White/violet	(W/V)	Spare
–	–	–	Turquoise	(T) cut back	–
–	–	Shell	Outer screen		Earth

* Standard extended control unit has 12 position Channel Switch. When used with 4 channel versions of transceiver, only positions 1–4 of Channel switch select channel crystals; in single channel version, channel select wiring is not connected at transceiver.

2.3.4 Loudspeaker Connection

The loudspeaker, type 11637A, is supplied with a 1·3m (4 ft) long flying lead. Run this lead into the control unit via the hole in the rear cover (after removal of the cover from the unit). Connect the flying lead to the push-on terminals marked "L/S".

2.3.5 Transceiver/Control Unit Interconnections

Interconnections between the transceiver and the extended control unit are made by means of a 4m (13 ft) long flat multi-core cable attached to the control unit and terminated in a 35 way plug. This connects to a 35 way socket on a short flying lead from the transceiver. The plug (Plessey type 74/10/3502/10) and socket (Plessey type 74/10/3551/10) are already fitted to the cables. It is only necessary to mate these connectors for all connections to be made.

Plug and socket connections are detailed in Table 2.1 opposite.

2.4 SETTING UP

2.4.1 Channelling

The MRT12 transceiver is normally dispatched from the factory equipped with the customer's specified channel crystals. The equipment is therefore ready for use on completion of the wiring detailed in section 2.3 above. If it is desired to make alterations or additions to the channels in use then reference should be made to Chapter 7. Note that transmit and receive frequencies of new channels must lie within 1% of the transmit and receive frequencies already fitted.

2.4.2 Timer Link

A PTT timer circuit is incorporated in the MRT12 transceiver. Use of the timer function is optional—when connected in circuit it limits transmission time to approximately 2 minutes. If the PTT switch is held down beyond this period, the timer overrides the PTT and switches the transmitter off. The timer is automatically reset on release of the PTT switch.

If the timer function is not required, the circuit may be disabled by connecting a link between pins 36 and 35 (0V) on the transmitter board (module 3). Timer operation can be subsequently restored if necessary simply by removing this link.

2.4.3 Modifying 24V Equipment for 12V

If necessary a 24V equipment may be modified to operate from a 12V supply. Open up the transceiver to expose the DC-DC converter (module 2)—see Fig. 8.1 (a) for location. On the switching PCB, remove the link between pins 5-6 and connect between pins 7-8; this bypasses the converter.

The following wiring changes must also be made in order to connect the remote on/off switch in circuit. Identify the wire connected to pin 3 on the converter switching PCB which runs from TS1 pin 14. Transfer this wire from pin 3 to pin a (upper) on the control PCB, leaving the other end connected to TS1 pin 14. Also leave in place the wire which is already connected to pin a (upper). Transfer the wire connected to pin a (lower) on the switching PCB to pin 3 on the same board (other end of this wire connects to TS1 pin 23).

Finally the in-line fuses must be increased from 3A to 5A for 12V operation (see para. 2.3.1).

2.5 INTERFERENCE SUPPRESSION

As with all vehicle mounted radio equipment, certain precautions must be taken to minimise interference from ignition and other electrical systems. The notes given below are intended for guidance only, and indicate the types of interference most likely to be encountered. Advice on other sources of interference (e.g. wheel static, tyre static, brake static) may be obtained from the Mobile Installation dept. of Redifon Telecommunications Ltd.

(i) To minimise interference pickup, the antenna down-lead(s) should be kept as short as possible, being kept well away from other electrical wiring. In no circumstances should a down-lead be routed along the same path as cables forming part of the vehicle electrical system. The interconnecting cable between the transceiver and control unit should also be kept away from the vehicle wiring.

(ii) With petrol-engined vehicles ensure that sparking plugs and distributor points are clean and correctly adjusted. Suppressors should be fitted to the common HT lead and to each sparking plug. Alternatively, resistive HT and plug leads may sometimes be fitted, and special RF shielded plug caps may also be fitted if available.

(iii) Interference from the vehicle generating system can be reduced by fitting a 0·1μF capacitor between the generator output lead and earth (generator frame).

(iv) If interference is experienced from the voltage regulator contacts, this can be reduced by fitting a capacitor and a low value resistor in series across the contacts; suggested values are 0·02μF and 4·7Ω respectively.

Notes to Fig. 2.2

(i) Unscrew clamp nut from plug body and remove parts shown in (A).

(ii) Slide the clamp nut and plain gasket* over the outer sheath (B).

(iii) Cut off the outer PVC sheath to 9·5mm (3/8 in) from end of cable, taking care to avoid damaging the braid (B).

(iv) Comb out the braid, then fold it out radially at right angles to the cable (C).

(v) Insert the ferrule between the dielectric and the braid, trapping the braid between the outer sheath and the ferrule (C). Trim off the surplus braid (D).

(vi) Cut off the dielectric to 0·5mm (1/64 in) from rear of the ferrule, taking care to avoid damaging the centre conductor (C).

(vii) Twist the strands together and check that length of centre conductor protruding from dielectric is 4·8mm (3/16 in) (C).

(viii) Tin the centre conductor, avoiding the use of excessive heat.

(ix) Slide the rear insulator over the dielectric to abut against the ferrule (D).

(x) Mount the contact (pin) over the centre conductor with shoulder pressed into the recess in the rear insulator. Hold the contact and cable tightly together and solder securely, avoiding the use of excessive heat (D). Remove surplus solder from outside of contact.

(xi) Slide the plain gasket* and clamp nut up to the ferrule, trapping the braid.

(xii) Push the sub-assembly into the plug body as far as it will go and engage the clamp nut in the thread.

(xiii) Hold the plug body and cable securely (so that the cable cannot twist) and tighten the clamp nut down hard.

*NOTE. The gasket should be used once only.

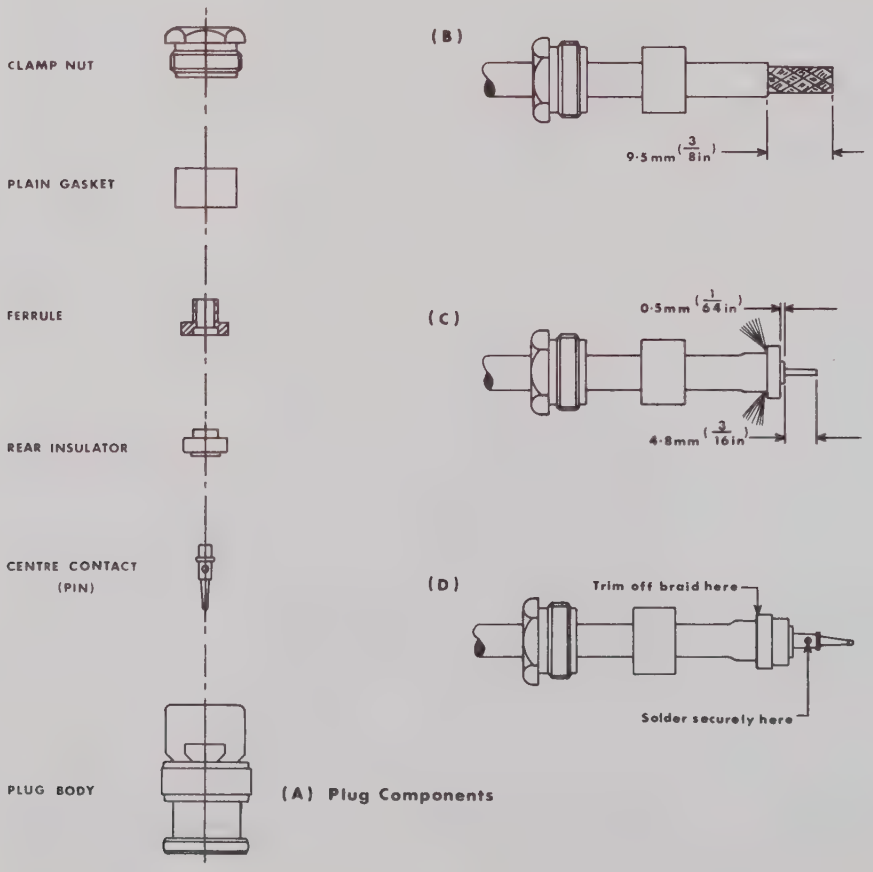


FIG.2.2

BNC COAXIAL PLUG DETAILS
(GE35070C10 – 50Ω)

1026-1

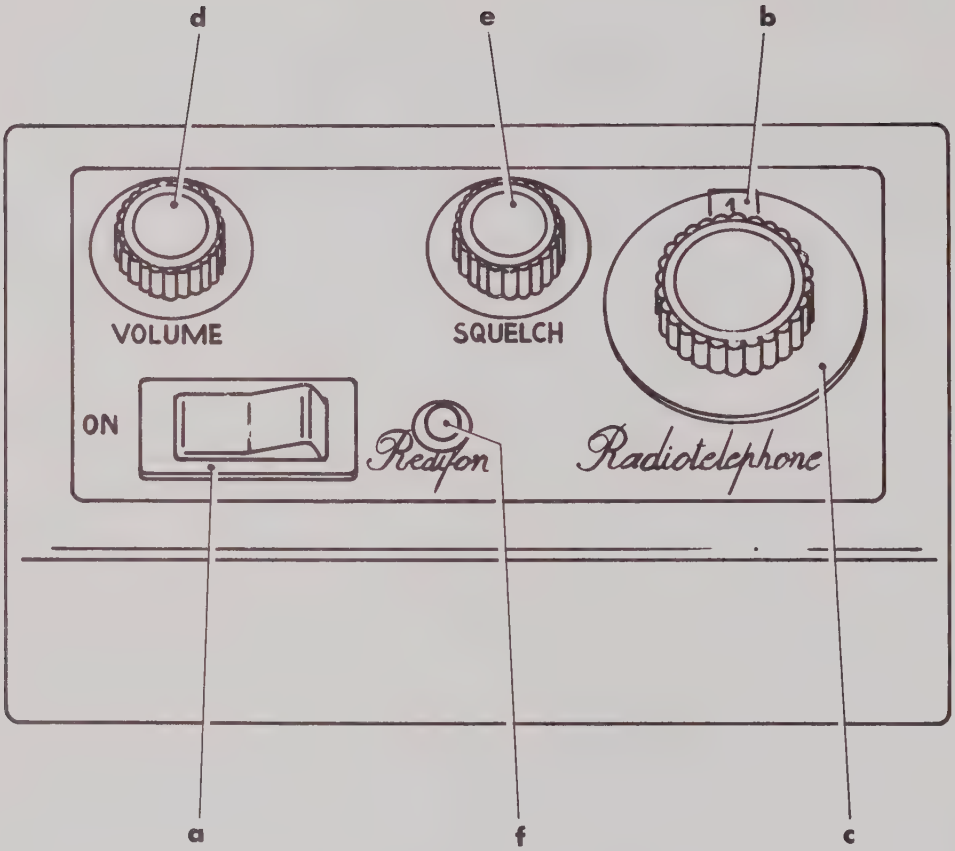
3 OPERATING INSTRUCTIONS

FIG.3.1 CONTROL UNIT FRONT PANEL LAYOUT

3.1 CONTROLS AND INDICATIONS

3.2 SQUELCH ADJUSTMENT

3.3 RADIOTELEPHONE OPERATION



CONTROL UNIT FRONT PANEL LAYOUT

FIG.3.1

3 OPERATING INSTRUCTIONS

3.1 CONTROLS AND INDICATIONS

All controls and indications listed below are on the control unit (see Fig. 3.1 opposite); the transceiver has no user controls.

(a) *SUPPLY ON/OFF SWITCH (7S2)*

Switches the 24V or 12V battery supply to the equipment ON or OFF.

(b) *SUPPLY ON LAMP (7LP1)*

Filament lamp, situated behind the Channel switch dial, which illuminates the dial to indicate that the supply is switched on, and the equipment is ready for use.

(c) *CHANNEL SWITCH (7S1)*

12 position switch, which selects operation on the required channel. When used with 4 channel equipments, only positions 1–4 select channel crystals in the transceiver. The switch wiring is not connected at the transceiver end when used with the single channel version.

(d) *VOLUME CONTROL (7R1)*

Variable control for adjusting the receiver audio output level to the loudspeaker.

(e) *SQUELCH CONTROL (7R2)*

Variable control for muting the receiver in the absence of incoming signals. This control must be adjusted carefully for best results (see section 3.2 below).

(f) *Tx ON LAMP (7D2)*

Light emitting diode (LED) which indicates that the transmitter is ON.

3.2 SQUELCH ADJUSTMENT

(i) Select a working channel with no incoming signal, and set the Volume control to mid-position.

(ii) Turn the Squelch control fully clockwise and check that receiver noise output is obtained.

(iii) Now turn the Squelch control slowly anticlockwise until the receiver is just muted. *CAUTION.* Do not turn the control any further than necessary; further anticlockwise rotation requires progressively larger signals to demute the receiver, and may result in weak signals not being received satisfactorily in fringe areas.

(iv) Check that all working channels are muted in the absence of incoming signals. Once set, the Squelch control should not normally require further adjustment.

3.3 RADIOTELEPHONE OPERATION

Operation of the MRT12 radiotelephone is straightforward; the procedure given below is applicable to all versions of the equipment.

(i) Select the required operating channel. Listen out to make sure that the channel is clear before transmitting.

(ii) Operate the press-to-talk (PTT) switch to switch the transmitter on; check that the Tx ON lamp lights. Speak close to the microphone at a moderate speech level.

(iii) Note that simplex operation only is available, i.e. the receiver is switched off during transmission. The PTT switch must be released to receive incoming signals.

(iv) If the PTT timer is in circuit (see para. 2.4.2) it is set each time the PTT switch is operated. If the switch is held down beyond the nominal 2 minute timer period, then the timer overrides the PTT and switches the transmitter off. The timer is automatically reset on release of the PTT switch.

4 CIRCUIT DESCRIPTION

4.1 INTRODUCTION

4.2 DC INPUT CIRCUITS (MODULE 2)
- 4.2.1 DC-DC Converter
- 4.2.2 12V Input Protection Circuit

4.3 TRANSMITTER CIRCUITS (MODULES 3, 4 & 5)
- 4.3.1 General
- 4.3.2 Switching Circuits
- 4.3.3 RF and AF Circuits
- 4.3.4 RF Power Amplifier
- 4.3.5 Antenna Filter

4.4 RECEIVER CIRCUITS (MODULE 6)
- 4.4.1 General
- 4.4.2 Antenna Switch
- 4.4.3 Front End and Mixer
- 4.4.4 IF and AF Circuits
- 4.4.5 Squelch
- 4.4.6 Supplies

4.5 EXTENDED CONTROL UNIT (MODULE 7)

4 CIRCUIT DESCRIPTION

4.1 INTRODUCTION

The MRT12 radiotelephone comprises two separate units interconnected by means of a multi-core cable. The transceiver unit contains the main circuits in modular form, i.e. chassis components/wiring (module 1), transmitter (3), RF power amplifier (4), antenna filter (5) and receiver (6). Module 2 comprises either a DC-DC converter (24V versions) or an input protection circuit (12V versions).

Control of the transceiver circuits is exercised by the extended control unit (module 7), to which the microphone, PTT switch and loudspeaker connections are also made.

4.2 DC INPUT CIRCUITS (MODULE 2)

4.2.1 DC-DC Converter (Fig. 8.4)

The DC-DC converter fitted to 24V versions of the equipment comprises two PCB's mounted together in a screened compartment adjacent to the heat sink plate. The function of this unit is to produce a stabilised +13·8V supply rail from the nominal 24V vehicle battery input, which may vary between 18–30V.

The basic converter circuit consists of a clock oscillator driving a pulse width modulator which is controlled from the output of a comparator. The pulses are fed via a driver circuit to an output switching stage and integrator. A current limit detector is built in, which overrides the comparator in the event of excessive current being drawn; also a current sensor which trips the clock oscillator if the current exceeds 1A in the absence of a PTT signal.

Referring to Fig. 8.4, the battery input is applied between pins 1 and 2 of the switching PCB. Input line filtering is provided by C17, L3. Zener diode D10 acts as a high voltage transient suppressor and, in conjunction with in-line fuses FS1, FS2, it also provides reverse polarity protection. The control PCB circuits are supplied from a +10V stabilised line produced by TR5, D4.

The clock oscillator comprises gates a and d of quad NOR gate IC1, the output (at about 75kHz) being taken from pin 3 of IC1a. R6 and D1 are connected across R7 to reduce the mark/space ratio. TR2 boosts the output current to charge C2, which is discharged by TR3. The rate of discharge of C2 depends on the current being drawn by the comparator TR4. This in turn depends on the converter output voltage at pin 3 of the switching PCB, a proportion of which is fed back to TR4 base by potential divider R18, R35, and compared with the reference voltage across D3 (4·7V).

Gates IC1b and c act as a trigger circuit whose triggering point is half the supply voltage. The output from pin 4 of IC1b is a pulse train whose frequency is that of the clock oscillator, but whose pulse width depends on the discharge rate of C2 (i.e. depends on the converter output voltage). These pulses are amplified by the current amplifiers TR6, 7 and 8. Diodes D5, D12 prevent TR7, TR8 from bottoming, and C7 defines the rise time of the drive waveform.

The amplified pulses from TR8 cause the output switching transistor TR9 to switch the filtered battery supply on and off at the clock oscillator frequency, the on/off times being determined by the mark/space ratio of the controlling signal. Components R20, L4, R21 apply reverse bias to TR9 on switch-off to reduce storage time. D7 is a flywheel diode providing a current path for L1 during the off period; it also clamps TR9 emitter to 0V during this period.

The integrating network L1, C11, C12 smoothes the switched waveform from TR9 and this is then fed via R24 to the line output filter comprising C15, L2, C16. The stabilised +13·8V output from the converter is taken from pins 3 and 4 (pin 4 at 0V) to the remaining transceiver circuits, and via link e-e back to the comparator input.

The voltage drop across R24 is sensed by TR10, which turns TR21 on if the current through R24 becomes excessive. This bypasses TR3 and discharges C2 to reduce the duty cycle and hence limit the converter output voltage. Components R22, TH1, R23 provide temperature compensation on the set current limit.

TR11 senses currents greater than 1A flowing through R24, and provides an input to pin 1 of IC2a. A positive voltage is applied to pin 13 of IC2d when the PTT switch is operated. Thus pin 11 of IC2d will only go positive when the 1A limit is exceeded in the absence of this PTT signal. IC2b and c act as a latch which latches off the clock oscillator IC1a, d if this condition should occur.

A 24V equipment may be modified for operation from a nominal 12V battery by disconnecting link 5-6 on the switching PCB, and connecting link 7-8. This bypasses the whole of the converter circuit described above with the exception of line input and output filtering. This modification also necessitates certain minor changes to the transceiver wiring in order to connect the remote on/off switch in circuit. These changes are detailed in para. 2.4.3.

4.2.2 12V Input Protection Circuit (Fig. 8.6)

Equipments designed for 12V operation are fitted with the protection circuit shown in Fig. 8.6. This comprises supply filtering components L1, C1, C2, C3, together with zener diode D1. This diode acts as a high voltage transient suppressor and, in conjunction with in-line fuses FS1, FS2, it also provides reverse polarity protection.

4.3. TRANSMITTER CIRCUITS (MODULES 3, 4 & 5)

4.3.1 General

The transmitter PCB (module 3) contains all the AF and low level RF transmitter stages, together with a nominal +9V stabiliser and all PTT and data switching circuits. This board hinges out from the frame for servicing. The RF power amplifier (module 4) is a wide band module with input, output and decoupling components mounted on an associated PCB.

The antenna filter (module 5) is contained in a separate screened compartment with the antenna socket mounted directly on the filter screening. On the two antenna version, the Tx antenna connects to this socket, a separate socket being provided for the Rx antenna.

4.3.2 Switching Circuits [Fig. 8.8 (a) or (b)]

Transistors TR19–TR23 form a +9V series stabiliser circuit supplied from the DC input at pin 14 (+13·8V in 24V versions of the equipment, or 12V unstabilised battery input in 12V versions). This stabiliser provides three outputs as follows:

(a) +9V continuous supply to the data switch and timer circuits (described below) and via pins 22 (two off) to other transceiver circuits.

(b) +9V Tx supply via TR22 to pin 21.

(c) +9V Rx supply via TR23 to pin 23.

Switching transistors TR22, TR23 are controlled by TR30, which in turn is governed by the timer IC2, TR29. The timer may be disabled, if this facility is not required, by linking pin 36 to pin 35 (0V). The circuit description below assumes that the timer is operational.

Normal PTT operation is obtained by connecting pin 18 to 0V. With TR26 conducting (see Note below) the PTT signal at pin 18 turns TR27 on. Collector current flow through R142, R143 causes TR28 to conduct, and pin 2 of IC2 is momentarily grounded via C103. Collector current flow through R144 turns TR29 off and releases pin 4 of IC2. This gives an output on pin 3 of IC2 for the time delay determined by R149, C102 (approximately 2 minutes). TR30 turns on, switching TR22 on and TR23 off, i.e. +9V Tx supply on. TR24 is a switching transistor which is not used in these equipments.

On release of the PTT switch, TR29 clamps pin 4 of IC2 to near 0V. This resets the timer, pin 3 of IC2 falling to 0V. TR30 turns off, switching TR22 off and TR23 on, i.e. +9V Rx supply on.

If the PTT connection is maintained beyond the nominal 2 minute period, the timer overrides the PTT. The output from pin 3 of IC2 falls to 0V, turning TR30 off. TR22 is therefore switched off, and TR23 on, i.e. the equipment reverts to the receive condition. The timer is not reset, however, until the PTT switch is released, allowing pin 4 of IC2 to be clamped to 0V.

NOTE. Interface circuits are built into the equipment to facilitate connection to a two-way data system. If DATA CONTROL operation is required, pin 31 is connected to 0V. TR25 is then cut off and its collector voltage rises. This performs the following functions:

(i) It cuts off TR26, thus switching off TR27 and removing PTT control from pin 18. TR26 also switches off the microphone pre-emphasis amplifier TR14, effectively isolating the microphone input.

(ii) It provides voltage via D25 and pin 24 to mute the receiver.

DATA Tx PTT is obtained by connecting pin 32 to 0V. This operates the timer IC2, TR29, thus switching the +9V Tx supply on for the timer period as described above.

4.3.3 RF and AF Circuits [Fig. 8.8 (a) or (b)]

12 channel equipments are fitted with three identical crystal oscillator stages TR2, TR3 and TR4, each provided with up to four diode-switched crystals. In 4 channel versions, TR3 and TR4 are not fitted, while in the single channel version, TR2 has only one crystal, wired permanently in circuit.

Selection of the required channel is achieved by connecting pins 1–4 or pins 1–12 as appropriate via the control unit Channel switch to 0V. The corresponding diode switch D1–D12 (as fitted) then conducts and connects the required channel crystal in circuit. The oscillator frequency is as shown below:

Low band	MRT12LB:	T ÷ 3	where T = transmit frequency
Mid band	MRT12MB:	T ÷ 4	
High band	MRT12HB:	T ÷ 6	

Oscillator output is taken via R37, R38 or R39 to buffer amplifier TR1, which feeds the phase modulator and multiplier chain as follows:

Low band	MRT12LB:	TR5, 6 & 7	phase modulator
		TR8 & 9	frequency tripler
		TR10	tuned amplifier
		TR31	amplifier
Mid band	MRT12MB:	TR5 & 6	phase modulator
		TR7	amplifier
		TR8	frequency doubler

	TR9	frequency doubler
	TR10	tuned amplifier
High band MRT12HB:	TR5 & 6	phase modulator
	TR7	amplifier
	TR8	frequency tripler
	TR9	amplifier
	TR10	frequency doubler

The multiplier output, at the required transmit frequency, is taken from TR31 (low band versions) or TR10 (mid band/high band versions). The drive level at this point is approx. 100mW in 50Ω; potentiometer R155 is used to reduce the drive level during alignment of the transmitter circuits. Transistors TR8, TR9, TR10 (and TR31 in low band versions) are supplied direct from the +13·8V stabilised line in 24V equipments, or the 12V unstabilised battery input in 12V equipments.

The audio signal from the control unit dynamic microphone is applied at pins 16, 17, and is fed via the pre-emphasis amplifier TR14 to clipper IC1, TR15. The clipper output, from pin 3 of IC1, is applied via the de-emphasis amplifier TR16 to the active low pass filter comprising TR17, TR18 and associated components. The output from the filter (at TR18 emitter) modulates the RF signal in the phase modulator TR5, TR6 (and TR7 in low band versions). Potentiometer R119 is used to preset the maximum deviation to ±2·5kHz or ±5kHz according to the minimum channel spacing (12·5kHz or 25kHz respectively).

For normal operation, pin 39 is linked to pin 40, and pin 38 to pin 21 (+9V Tx). The transmitter oscillator and audio sections are therefore switched on only on transmit.

For DATA CONTROL operation, these links are reconnected as follows: pin 38 to pin 22 (+9V cont.) and pin 39 to pin 41 (+9V Tx). The oscillator and audio sections, with the exception of TR18, are therefore on continuously, TR18 being switched on only on transmit—this ensures a fast transmitter rise time.

The DATA input is applied at pins 30, 29 and is fed to the phase correcting circuit TR11, 12 and 13; this circuit has a flat frequency response. The output from TR13 emitter is fed to clipper IC1, TR15, the remaining circuits being as described above.

TR26 removes the HT supply from microphone pre-emphasis amplifier TR14, thus isolating the microphone input [see Note (i) in section 4.3.2].

4.3.4 RF Power Amplifier [Fig. 8.10 (a)]

The power amplifier (module 4) is a wide band integrated amplifier which raises the RF power level from the transmitter PCB from a nominal 100mW to greater than 13W. In 24V versions of the equipment this device is supplied from the +13·8V stabilised line, giving a constant power output. In 12V versions it is supplied from the 12V unstabilised battery input, and the power output is therefore dependent on the battery voltage.

This module requires no alignment or adjustment. The associated PCB carries decoupling capacitors C1, C2 and "microstrip" transmission lines X1, X2 which form part of the input and output matching circuits.

4.3.5 Antenna Filter [Fig. 8.10 (b)]

The antenna filter (module 5) is a four section constant K low pass design. The filter is set up on factory test for the correct bandpass characteristic. No adjustments are provided, and the module should be regarded as a sealed unit. The antenna socket forms part of the assembly. Capacitor C6 isolates the transmitter 0V line from the antenna ground connection (transceiver case).

4.4 RECEIVER CIRCUITS (MODULE 6)

4.4.1 General

The receiver (module 6) is a single superheterodyne with an intermediate frequency of 10·7MHz; local oscillator injection is 10·7MHz below the required channel frequency. Also included on this board are the detector and AF amplifier providing an output of at least 2W into 3Ω. The board hinges out from the frame for servicing.

4.4.2 Antenna Switch [Fig. 8.2 (b) or (c)]

In single antenna versions of the equipment, the transmitter output and receiver input are connected to the antenna filter "input" terminals by critical length coaxial lines X1, X2. The receiver line X2 is terminated in two back-to-back diodes D1, D2 (mounted at TS2a, b). This point is then cabled to the receiver input at pins 20, 19.

In the receive condition, the output impedance of the transmitter is transformed to a high impedance at the antenna filter, due to impedance transformation in line X1. This prevents loss of receiver sensitivity.

In the transmit condition diodes D1, D2 conduct, thus preventing the high transmitter output voltages from being applied to the receiver input. The low impedance of the conducting diodes is transformed by line X2 to a high impedance at the antenna filter. This prevents loss of transmitter power output.

NOTES.

1. The antenna switch is not fitted to the two antenna version of the equipment.

2. The lengths of coaxial lines X1 and X2 are detailed in section 5.7.

4.4.3 Front End and Mixer [Fig. 8.13 (a) or (b)]

In the receive mode, the incoming signal from the single antenna is fed via the antenna switch described above to pins 20, 19 on the receiver board (direct connection from Rx antenna in the two antenna version). The antenna signal is amplified by the tuned RF amplifier stage TR1, this device being a dual insulated gate field effect transistor (dual IGFET). TR1 input (gate 1) is tuned by L2, 3, 4 and associated components, and the output (drain) by L5–L9 and associated components. Capacitors C1 and C110 isolate the receiver 0V line from the antenna ground connection (transceiver case). The amplified RF signal from TR1 is applied to mixer D1–D4.

Local oscillator injection for the mixer is derived as follows. 12 channel equipments are fitted with three identical crystal oscillator stages TR7, TR8 and TR9, each provided with up to four diode-switched crystals. In 4 channel versions, TR8 and TR9 are not fitted, while in the single channel version, TR7 has only one crystal, wired permanently in circuit.

Selection of the required channel is by connecting pins 1–4 or pins 1–12 as appropriate via the control unit Channel switch to 0V. The corresponding diode switch D7–D18 (as fitted) then conducts and connects the required channel crystal in circuit. The oscillator frequency is as shown below:

Low band MRT12LB:	(R – 10·7MHz) ÷ 2	where R = receive frequency
Mid band MRT12MB:	(R – 10·7MHz) ÷ 4	
High band MRT12HB:	(R – 10·7MHz) ÷ 4	

Oscillator output is taken via R62, R63 or R64 to buffer amplifier TR6, which feeds the frequency multiplier stage(s) TR3/TR4 (mounted in a separate screened compartment). The multiplier transistor functions are as follows:

Low band MRT12LB: TR3 x 2, TR4 amplifier
Mid band MRT12MB: TR3 x 2, TR4 x 2
High band MRT12HB: TR3 x 2, TR4 x 2

The multiplier output, at 10·7MHz below the required channel receive frequency, is applied to mixer D1–D4 where it is mixed with the amplified antenna signal.

4.4.4 IF and AF Circuits [Fig. 8.13 (a) or (b)]

The 10·7MHz output from the mixer is fed via crystal filter FL1 to tuned IF amplifier TR2 (dual IGFET). The signal is then applied via a second crystal filter FL2 to the integrated IF amplifier IC1. Integrated circuit IC2 comprises an IF amplifier, limiter and discriminator (detector), which recovers the audio modulation from the received signal. External tuned circuit L13 forms part of the discriminator circuit.

The buffered low level audio output from IC2 is fed via AF preamplifier TR5 to the voltage variable "volume" attenuator IC3. The attenuation of this device is controlled by the resistance presented between pin 2 and 0V. The variable volume controlling resistance is adjusted by means of the control unit Volume control 7R1 (see Fig. 8.15) and presented at pin 18 of the receiver board via the interconnecting cable (resistors R127, 128, 129 not used in these equipments).

The output from IC3 is applied via de-emphasis amplifier TR10 and amplifier TR11 to the active low pass filter TR12. The signal at TR12 emitter is connected via a link between pins 44-45 to the input of AF power amplifier TR13-TR18. This amplifier provides an output of at least 2W into the external 3Ω loudspeaker, with less than 5% distortion.

Integrated amplifier IC5 is also fed from the AF preamplifier TR5. This amplifier incorporates a de-emphasis characteristic, and provides data audio output on DATA CONTROL operation. The squelch circuit (described below) does not affect the data output.

4.4.5 Squelch [Fig. 8.13 (a) or (b)]

The output from AF preamplifier TR5 is also applied to the voltage variable "squelch" attenuator IC4. The attenuation of this device is controlled by the resistance presented between pin 2 and 0V. The variable squelch controlling resistance is adjusted by means of the control unit Squelch control 7R2 (see Fig. 8.15) and presented at pin 21 of the receiver board via the interconnecting cable.

The output from IC4 is fed via active high pass filter TR19 (cut-off frequency about 8kHz) to noise amplifier TR20. The noise output from TR20 is detected by TR21, which controls the muting switch TR22. In the absence of an incoming signal the detected receiver noise turns TR21 on, causing TR22 to conduct. This cuts off AF amplifier TR11 and hence mutes the receiver.

On DATA CONTROL operation, the switching circuits in the transmitter apply a positive voltage to pin 24 [see Note (ii) in section 4.3.2]. This operates TR22 directly and hence mutes the receiver as above; the data output is not, of course, muted.

4.4.6 Supplies [Fig. 8.13 (a) or (b)]

In 24V versions of the equipment, the AF power amplifier transistors TR13-TR18 are supplied from the

+13·8V stabilised line at pin 14 (12V unstabilised battery input in 12V versions). The crystal oscillators, frequency multiplier, RF front end and first IF stage TR2 are supplied from the +9V cont. supply at pins 22 and 47. The remaining IF and audio circuits are supplied from the +9V Rx line (pin 23) and are therefore switched off when transmitting.

4.5 EXTENDED CONTROL UNIT (MODULE 7)

The MRT12 transceiver has no user controls, these being fitted to the extended control unit. Interconnections between the two units are made by means of a 4m (13 ft) long multi-core flying lead from the control unit, which plugs into a short flying lead from the transceiver.

Referring to Fig. 8.15, the Channel switch S1 connects contacts 1–12 to 0V. Positions 1–12 of the switch are connected via the interconnecting cable to the corresponding pins on the transmitter and receiver boards [see Fig. 8.2 (a), (b) or (c)]. The 0V connection on these pins operates the oscillator diode switches and connects the appropriate crystals in circuit for the required channel.

In 4 channel versions of the transceiver, only positions 1–4 of the control unit Channel switch select crystals on the transmitter and receiver boards. In the single channel version, although the Channel switch wiring is connected to the transmitter and receiver boards, the oscillator transistors are provided with only one crystal each. These crystals are permanently selected by means of wire links, i.e. Channel switch inoperative.

The Volume control R1 presents a variable resistance to 0V. This resistance is connected via the interconnecting cable to the transceiver, where it is applied via pin 18 on the receiver board to the control input of "volume" attenuator IC3 [Fig. 8.13 (a) or (b)]. The receiver output from the audio power amplifier is fed back to the control unit via 8 cores of the interconnecting cable (4 cores feed, 4 cores return) where it is then connected to the external loudspeaker.

The Squelch control R2 also presents a variable resistance to 0V. This resistance is connected via the interconnecting cable to the transceiver, where it is applied via pin 21 on the receiver board to the control input of "squelch" attenuator IC4 [Fig. 8.13 (a) or (b)].

Indicator lamp LP1 is supplied from the +13·8V stabilised/12V unstabilised line which is fed to the control unit via the interconnecting cable. This lamp is mounted behind the Channel switch dial, and illuminates the dial to indicate that the equipment is ON.

The dynamic microphone is connected to the control unit either directly or via a 2-pin snap connector (optional). At the control unit, the microphone is connected to two cores of the interconnecting cable. At the transceiver, these cores are connected via pins 16, 17 on the transmitter board to the microphone pre-emphasis amplifier TR14 [Fig. 8.8 (a) or (b)].

The PTT switch is normally integral with the fist microphone (as supplied), but in some cases may be connected separately to the control unit via a 2-pin snap connector (optional). Operation of the switch applies a 0V PTT signal via the interconnecting cable and via pin 18 on the transmitter board to the PTT switching circuit (see section 4.3.2). The PTT switch also applies 0V to the Tx ON indicating lamp D2 (a light emitting diode or LED), which is situated on the control unit front panel, below the Squelch control. The LED is fed from the +13·8V stabilised/12V unstabilised supply, via R3.

5 MAINTENANCE AND REPAIR

5.1 ROUTINE MAINTENANCE

5.2 REPLACEMENT OF FUSES

5.3 REPLACEMENT OF LAMPS

5.4 REPAIRS TO PRINTED CIRCUIT BOARDS
- 5.4.1 Soldering
- 5.4.2 Component Replacement

5.5 SEMICONDUCTOR PRECAUTIONS

5.6 TOXIC MATERIALS WARNING

5.7 ANTENNA SWITCH LINE LENGTHS

5 MAINTENANCE AND REPAIR

5.1 ROUTINE MAINTENANCE

The maintenance procedures described below should be carried out at regular intervals (e.g. every 6 months). Check that all units are secure in their mountings, and examine the transceiver and control unit for mechanical damage, corrosion etc. Pay particular attention to the transceiver main earth connection, as any corrosion at this point can considerably reduce the performance of the equipment.

Carry out a visual check of all wiring, and check that the plug/socket connections are secure. Examine the antenna(e) and feeder cable(s) for signs of damage, and check that the antenna mounting bolts are tight. Also check the feeder connections at both ends of the cable, paying particular attention to the outer (screen) connections.

Finally, by use of the microphone/PTT switch, check the equipment operationally.

5.2 REPLACEMENT OF FUSES

Fuses FS1 and FS2 are fitted in the supply lines to the transceiver unit (in-line fuseholders). Replacement fuses are Belling Lee cartridges type L1055 rated at 3A fast blow for 24V versions, or 5A fast blow for 12V versions. Fuse dimensions are 32mm x 6·3mm (1¼in x ¼in). *CAUTION.* These current ratings mut not be exceeded.

5.3 REPLACEMENT OF LAMPS

The SUPPLY ON indicator lamp is fitted behind the Channel switch dial. To gain access the cover must be removed from the control unit (two hexagon headed screws at rear of unit). The replacement lamp is Vitality 24V, 40mA LES, type 687.

The Tx ON indicator lamp is a light emitting diode (LED). It is fitted from the back of the control unit panel and retained by a snap-fit plastic mount.

To replace the LED proceed as follows. Push back the insulating sleeves on the faulty LED and unsolder the white and black leads. Remove the device by pushing it out through the plastic mount from the front. Fit the new LED (Radiospares type 586-475 Red) into the mount from the back and push it fully home, ensuring that a snap-fit is obtained.

The LED cathode connection is identified by the adjacent flat on the body flange. Solder the black lead to this pin and the white lead to the anode pin; avoid overheating the device by prolonged application of the iron. Finally push the insulating sleeves over the LED connections.

5.4 REPAIRS TO PRINTED CIRCUIT BOARDS

If the faultfinding procedures described in chapter 6 indicate that component replacement is necessary, proceed as follows. The faulty printed circuit board may be serviced by removing the mounting screws and carefully lifting the board free from the wiring. It should not normally be necessary to remove the board completely from the unit unless it is to be replaced by a new or serviced spare.

When carrying out repairs to printed circuit boards, it is suggested that the procedures given below be adopted.

5.4.1 Soldering

(a) The use of unregulated soldering irons with a rating greater than 25W should be avoided. However, temperature regulated irons up to 60W may be used if care is exercised.

(b) The most convenient soldering iron bit is a pencil type, not exceeding 5mm (3/16in) diameter, with the end filed at an angle.

(c) The printed circuit board must not be overheated by prolonged application of the soldering iron; such action could destroy the bond between the copper foil and the board.

(d) Only approved resin-cored solder to BS441, and preferably of 20 swg, must be used.

5.4.2 Component Replacement

(a) The simplest way to remove a faulty component is to cut the component leads as close as possible to the top surface of the board. The joints should then be heated with a freshly tinned iron, and the remaining pieces of component lead pulled out from the bottom of the board using snipe-nosed pliers or stout tweezers.

(b) It *may* be possible to extract a suspect integrated circuit by removing the solder from each joint in turn using either a suction de-soldering tool or a de-soldering wick.

(c) When the faulty component has been removed, all solder must be cleared from the holes in the board. For this purpose, a fine sewing needle or a component

lead of the appropriate diameter may be used; alternatively a matchstick may be used, having first been sharpened to a point.

(d) Great care is necessary when fitting the new component. The leads must be bent to the exact centres of the holes, at the same time ensuring that the component is not damaged.

(e) When inserting the component leads into the holes in the circuit board, take care not to push the copper away from the board.

(f) When making soldered joints the iron should be applied to one side of the component lead where it touches the copper track, and the solder to the other. As soon as the solder flows, remove the iron and the solder from the joint. When soldering semiconductor devices, avoid prolonged application of the iron which could damage the device [see also para. 5.5 (b)].

(g) Ensure that the component is held firmly in place until the solder has solidified. When the joints have cooled, cut off the surplus wire.

(h) Before re-assembly, inspect the circuit board for droplets of solder which may have been splashed over its surface. If left, these could short circuit adjacent tracks.

(j) If a portion of the printed wiring is damaged, it may be cut out with a very sharp knife and replaced by a piece of insulated copper wire. This should be soldered between two points where components are soldered to the track, rather than to the foil itself.

5.5 SEMICONDUCTOR PRECAUTIONS

Although semiconductor devices (e.g. diodes, transistors, integrated circuits) are extremely robust and have an exceptionally long life, they are easily damaged by misuse. The following precautions must be observed when working on the equipment:

(a) Low impedance devices, such as buzzers, must NEVER be used for point-to-point wiring checks; the high transient voltages generated could easily damage transistors etc. in the circuit. An ohmmeter may be used provided that the current passed does not exceed 1mA, and that polarity is observed.

(b) Soldering irons must always have an effective earth connection to guard against possible damage from leakage current.

5.6 TOXIC MATERIALS WARNING

Attention is drawn to the fact that the RF power amplifier modules used in the MRT12 transceivers contain Beryllium Oxide—a highly toxic material. Precautions must therefore be taken when handling or disposing of these devices.* The necessary precautions are outlined in a warning sheet at the front of this handbook, and these must be strictly observed. It should be emphasised that no health hazard exists in normal use, but the modules must NEVER be broken open.

*For details of the relevant device type nos. see power amplifier component list 8.9.1.

5.7 ANTENNA SWITCH LINE LENGTHS

The antenna switch circuit fitted to single antenna equipments depends for its operation on two critical length coaxial lines X1 and X2 (principles of operation are described in para. 4.4.2). If these lines should become damaged, they must be replaced by the correct lengths of cable as listed in the table below. The cable is 50Ω BICC type T3264.

	*Line X1: PA output to antenna filter**	*Line X2: antenna filter to diode terminal block (receiver feed)**
Low band	70mm (2¾ in)	616mm (24¼ in)
Mid band	381mm (15 in)	381mm (15 in)
High band	127mm (5 in)	330mm (13 in)

*All cable lengths ±4·7mm (±3/16 in)

6 FAULTFINDING AND REALIGNMENT

6.1 ACCESS TO UNITS

6.2 INITIAL CHECKS

6.3 TYPICAL TRANSMITTER VOLTAGES AND LEVELS
- 6.3.1 DC Measurements
  - Table 6.1 Incoming and Outgoing Supplies
  - Table 6.2 Transistor Voltages
  - Table 6.3 IC Voltages
- 6.3.2 RF and AF Measurements

6.4 TYPICAL RECEIVER VOLTAGES AND LEVELS
- 6.4.1 DC Measurements
  - Table 6.4 Incoming Supplies
  - Table 6.5 Transistor Voltages
  - Table 6.6 Transistor Voltages with Receiver Muted
  - Table 6.7 IC Voltages
- 6.4.2 RF and IF Measurements

6.5 TESTING AND REALIGNMENT
- 6.5.1 General
- 6.5.2 Test Equipment Required
- 6.5.3 Core Locking

6.6 DC-DC CONVERTER TEST

6.7 TRANSMITTER ALIGNMENT

6.8 RF POWER AMPLIFIER TEST

6.9 ANTENNA FILTER TEST

6.10 RECEIVER ALIGNMENT

6 FAULTFINDING AND REALIGNMENT

6.1 ACCESS TO UNITS

Before removing the transceiver unit from its frame disconnect the supply leads, the antenna plug(s) and the interconnecting cable. Remove the unit by releasing the two quick-release clips.

Free the cover from the unit by removing the four 4BA screws, on in each corner of the heat sink plate. Slide off cover in direction of heat sink plate.

Remove six 6BA securing screws from receiver board and hinge up board for access to all adjustments. *Note.* The receiver board is identified by the small screening board on the outside.

Access to units mounted on the rear of the heat sink plate (i.e. DC-DC converter, RF power amplifier, antenna filter) may be gained by removing the four 4BA countersunk screws, one in each corner of the heat sink plate. The plate may then be placed horizontally; if required the equipment may be operated with the plate in this position.

Release the extended control unit from its frame by removing the two hexagon-headed pivot bolts. The rear cover of the control unit is then free, and may be removed for access.

6.2 INITIAL CHECKS

Check that the supply leads are electrically isolated from the frame using multirange testmeter, e.g. Avo model 8, set to Ω.

Check that the DC-DC converter (if fitted) is correctly set for the available bench supply voltage, i.e. link pins 5-6 for 20–30V (4A) unstabilised supply or variables PSU (converter in circuit). If a 24V equipment is to be operated from a 13·8V (5A) stabilised supply, the converter must be bypassed and certain minor changes must be made to the transceiver wiring. For full details see para. 2.4.3.

Connect the multicore cable from the control unit to the transceiver flying lead. Connect the supply to the transceiver via the in-line fuses; fuse ratings are 3A for 20–30V operation, 5A for 13·8V.

Switch on at the control unit and check that the SUPPLY ON indicator lamp (behind channel switch dial) lights.

If 20–30V unstabilised or variable supply is used, check that converter output voltage, measured between pins 14 and 15 on receiver board, lies in the range 13·7–14·0V (pin 15 is 0V). The preset potentiometer for adjusting the voltage may be reached through the hole in the converter top cover. It is set for 13·8V ±0·05V at an input voltage of 27·6V and a converter output current of 1A (see section 6.6 for full details of testing and adjustment).

6.3 TYPICAL TRANSMITTER VOLTAGES AND LEVELS

6.3.1 DC Measurements

All voltage measurements are made relative to 0V, using multirange testmeter, e.g. Avo model 8. Measurement conditions are as follows:

(i) Timer disabled by linking pins 36-35 (if timer operation is required in the installation then this link must be removed on completion of the measurements).

(ii) PTT switch on. If control unit is supplied with optional 2-pin plug and socket connectors on flying leads, a PTT switch must be connected to the red coded socket. If the standard fist microphone with integral PTT switch is supplied, no external PTT connections are necessary. Check that the Tx ON lamp on the control unit lights.

(iii) Unless otherwise stated, channel oscillator is off; switch to channel position with no crystal fitted, or remove connection from appropriate control pin 1–12.

Table 6.1 Incoming and Outgoing Supplies

Pin no.	*Voltage (V)*
14	13·8
21	9·4
22	8·4
23	0
24	2·0
31	4·8
37	0
39	9·4

Table 6.2 Transistor Voltages

Ct. ref.	*Emitter (V)*	*Base (V)*	*Collector (V)*
TR1	1·2	2·0	9·0
TR2	3·5	4·1	8·3
TR3 } 12 ch.	3·5	4·1	8·3
TR4 } only	3·5	4·1	8·3
TR5	1·5	2·2	6·0

Table 6.2 contd.

Ct. ref.	Emitter (V)	Base (V)	Collector (V)
TR6	1·5	2·2	6·0
TR7	2·5 (1·3)	3·2 (2·0)	8·7 (6·2)
TR8	0 (1·0)	0·6 (1·6)	13·8 (9·0)
TR9	2·5 (0·3)	3·1 (1·0)	11·5 (9·0)
TR10	1·3* (2·0)	– (2·5)	10·0*(13·8)
TR31 (low) band only	(0·5*)	–	(12·5*)
TR11	5·8	–	2·8
TR12	–	–	9·0
TR13	1·5	–	9·0
TR14	1·8	–	4·8
TR15	3·1	–	0·7
TR16	2·4	–	6·0
TR17	5·3	–	9·0
TR18	4·4	–	9·0
TR19	4·4	–	13·0
TR20	13·8	–	9·5
TR21	4·4	–	9·5
TR22	9·5	8·6	9·4
TR23	9·5	9·2	0
TR24	0	0·8	0
TR25	0	0·8	0·1
TR26	–	7·6	8·3
TR27	–	7·6	8·3
TR28	0	0·8	0·1
TR29	0	–	5·6
TR30	0	0·8	0·1

NOTES

1. Figures in brackets refer to low band transmitter PCB.
2. Figures marked * taken with channel oscillator on, and circuits tuned for maximum RF output.

Table 6.3 IC Voltages

Ct. ref.	Pin no.							
	1	2	3	4	5	6	7	8
IC1	0·7	5·5	3·1	0	–	–	–	–
IC2	0	2·7	7·0	5·5	5·5	0	0	8·4

6.3.2 RF and AF Measurements

For these measurements, the following test equipment is required:

RF valve voltmeter 0–3V, 174MHz, e.g. Dymar 1711
AF millivoltmeter e.g. Advance VM77D
AF oscilloscope e.g. Advance OS140
AF signal generator 600Ω, e.g. Advance J2E
Resistors 30kΩ, 1/8W
50Ω, 1/4W non inductive.

(a) Disable timer by linking pins 36-35, and operate PTT switch [see introductory notes (i) and (ii) in para. 6.3.1].

(b) Channel oscillator output level at pins 26, 25 (pin 25 at 0V) should be greater than 400mV rms on all channels.

(c) Disconnect coaxial cable from pins 20, 19. Connect 50Ω non inductive resistor between these pins, and connect RF valve voltmeter across this resistor (pin 19 at 0V).

(d) With potentiometer R155 fully clockwise, RF output level should be greater than 2·2V rms (mid band/high band) or 1·8V (low band).

(e) AF sensitivity and response are shown in the table below. Connect AF signal generator via 30kΩ resistor to TS1/16 and 17 in control unit (disconnect microphone leads from these terminals). If control unit is supplied with optional flying lead connectors, connect AF signal generator via 30kΩ resistor to the blue coded plug. Set generator to 10mV emf output, and frequency initially to 1kHz. Connect AF millivoltmeter to pins 42, 15 (pin 15 at 0V).

Frequency	Measurement
1kHz	4 to 6mV = 0dB ref
300Hz	+1 to -3dB
2·5kHz	+1 to -3dB
3kHz	at least 1dB down
6kHz	at least 20dB down

(f) Check audio clipping performance as follows. Connect AF oscilloscope between junction R106/R107 and pin 15 (pin 15 at 0V); leave generator and millivoltmeter connected as in (e). Set generator frequency to 1kHz and increase level until clipping of the waveform is just visible. Increase level by 20dB and check that output level does not increase by more than 3dB.

(g) Switch off the PSU, disconnect all test instruments and reconnect coaxial cable to pins 20, 19.

6.4 TYPICAL RECEIVER VOLTAGES AND LEVELS

6.4.1 DC Measurements

All voltage measurements are made relative to 0V, using multirange testmeter, e.g. Avo model 8. Measurement conditions are as follows:

(i) PTT switch off.

(ii) No RF input.

(iii) Volume control fully clockwise.

(iv) Unless otherwise stated, receiver is unmuted (squelch control fully clockwise).

(v) Unless otherwise stated, channel oscillator is off (switch to channel position with no crystal fitted, or remove connection from appropriate control pin 1–12).

Table 6.4 Incoming Supplies

Pin no.	*Voltage (V)*
13	8·4
14	13·8
22	8·4
23	9·4
47	8·4

Table 6.5 Transistor Voltages

Ct. ref.	*Emitter/ Source (V)*	*Base/ Gate 2 (V)*	*Collector/ Drain (V)*
TR1	1·5 (1·0)	4·0 (1·2)	7·5
TR2	1·5	4·0	7·5
TR3	0	0·6	8·0
TR4	0	0·6	8·0
TR5	4·0	3·5	0·8
TR6	1·5	2·1	8·4
TR7	3·5	4·0	8·4
TR8 (12 ch. only)	3·5	4·0	8·4
TR9 (12 ch. only)	3·5	4·0	8·4
TR10	2·0	–	5·3
TR11	0·5	1·0	5·0
TR12	4·0	4·6	9·4
TR13	0	0·6	6·0
TR14	–	6·5	7·5
TR15	7·0	–	13·8
TR16	6·5	–	0·5
TR17	6·5	–	13·8
TR18	0	–	6·5
TR19	0·8	1·3	9·4
TR20	0·2	0·8	5·2
TR21	9·0	8·2*	0·1
TR22	0	0·1	4·0

NOTES

1. Figures in brackets refer to low band receiver PCB.
2. Receiver mutes when reading marked * is taken.

Table 6.6 Transistor Voltages with Receiver Muted

For the following measurements the squelch control is turned fully anticlockwise; other conditions unchanged. Return squelch to fully clockwise position after these measurements.

Ct. ref.	*Emitter (V)*	*Base (V)*	*Collector (V)*
TR19	0·8	1·3	9·0
TR20	0·2	0·8	5·2
TR21	8·5	9·1	1·6
TR22	0	0·7	0
TR12	0	0	9·0

Table 6.7 IC Voltages

Ct. ref.	*Pin no.*											
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*12*	*13*	*14*
IC1	0	3·0	0	2·3	6·2	8·9	9·1	0	–	–	–	–
IC2	3·6	3·5	–	1·4	1·4	1·4	0	0	0·2	3·5	7·8	3·7
IC3	1·0	3·2	0	–	–	5·3	4·5	8·5	–	–	–	–
IC4	1·0	3·2	0	–	–	5·3	4·5	8·5	–	–	–	–
IC5	–	1·4	4·5	0	–	4·7	9·0	–	–	–	–	–

6.4.2 RF and IF Measurements

For these measurements, the following test equipment is required:

RF valve voltmeter 0–3V, 160MHz, e.g. Dymar 1711
HF/VHF signal generator (50Ω) 10·7MHz and 68–174MHz with FM, e.g. Marconi TF2008
AF power meter 3Ω, 3W e.g. Marconi TF893A

(a) Channel oscillator output level at pins 34, 33 (pin 33 at 0V) should be greater than 400mV rms on all channels.

(b) Local oscillator injection level to mixer at pins 36, 35 (pin 35 at 0V) should be greater than 500mV rms.

(c) Main IF sensitivity may be checked as follows. Disconnect coaxial lead from pins 28, 27 and connect RF signal generator to these pins (pin 27 at 0V). Set generator to 10μV emf at 10·7MHz. Using 1kHz modulation frequency, set deviation to ±1·6kHz (12·5kHz system) or ±3·0kHz (25kHz system). Signal/noise ratio measured at loudspeaker output should be at least 10dB. Reconnect the lead to pins 28, 27 after this test.

(d) Front end and 1st IF stage gain may be checked as follows. Signal of 1·5mV emf at channel receive

frequency, connected to the (Rx) antenna socket, should give IF level of at least 100mV rms at pins 26, 25 (pin 25 at 0V). Leave the coaxial lead connected for this test, but T3, C15 may require adjustment to restore state of tune. Instructions for resetting T3, C15 (if necessary) are given in section 6.10 paras. (h) and (j).

(e) Switch off the PSU and disconnect all test instruments.

6.5 TESTING AND REALIGNMENT

6.5.1 General

The procedures given in sections 6.3 and 6.4 above will enable a faulty component to be located. Replacement of certain components may necessitate realignment of associated tuned circuits. The testing and realignment procedures which follow should be undertaken only by skilled personnel using test equipment of the required standard. A list of the recommended test equipment for complete testing and realignment of the MRT12 radiotelephone is given in section 6.5.2 below; suitable alternatives may of course be used.

For details of channel frequency checks or setting up new channels, refer to chapter 7.

6.5.2 Test Equipment Required

Power supply unit 18–32V variable (4A) or 13·8V stabilised (5A) as appropriate
Multirange testmeter e.g. Avo model 8 (2 off)
Variable resistor 30Ω, 4W
Fixed resistors 47kΩ, 1/2W
30kΩ, 1/8W
AF oscilloscope e.g. Advance OS140
AF signal generator 600Ω, e.g. Advance J2E
AF millivoltmeter e.g. Advance VM77D
VHF power meter/load 50Ω, 20W, 68–174MHz with suitable attenuated tap for connection of deviation meter
VHF deviation meter 68–174MHz, 0 to ±5kHz deviation, with demodulated output for connection of AF oscilloscope, e.g. Dymar 1785
AF power meter 3Ω, 3W, e.g. Marconi TF893A
Noise and distortion meter e.g. Dymar 1765
VHF signal generator 50Ω, 68–174MHz, with FM, e.g. Marconi TF2008
RF valve voltmeter 0–3V, 68–174MHz, e.g. Dymar 1711

6.5.3 Core Locking

When adjusting variable coil cores, note that these are assembled using core locking compound type 8G (Rocol Ltd). If any core is removed from a coil, it should be lightly coated with core locking compound before being refitted to the coil.

6.6 DC-DC CONVERTER TEST

(a) Disconnect leads from pins 1, 2, 3 and 4 of converter switching PCB. Connect variable PSU output to pins 1 and 2 (pin 1 positive).

(b) Connect testmeter 1 (on 10A DC range) and 30Ω 4W variable resistor in series between pins 3 and 4 (pin 3 positive). Set variable resistor to maximum resistance.

(c) Connect testmeter 2 (on 30V DC range) between pins 3 and 4.

(d) Ensure that pins 5 and 6 are linked, but not pins 7 and 8.

(e) Connect 47kΩ resistor between pins 9 and 3.

(f) Switch on the PSU and set to 27·6V. If necessary, adjust R35 for converter output of approximately 14V (testmeter 2).

(g) Adjust variable resistor for 1A load current and adjust R35 for converter output of 13·8V ±0·05V.

(h) Connect oscilloscope between pins b and 4 (pin 4 at 0V) and check that a square wave is obtained with a period of 12–14μS.

(j) Disconnect one end of the 47kΩ resistor and check that converter output remains constant; reconnect the resistor.

(k) Adjust variable resistor for 2·8A load current and check that converter output does not drop below 13·5V. Input current should not exceed 1·9A.

(l) Disconnect one end of the 47kΩ resistor and check that converter output drops to zero.

(m) Switch off the PSU, and allow to discharge. Reconnect the 47kΩ resistor.

(n) Switch on the PSU and reduce the variable resistor value, observing the load current at which the converter output voltage starts to drop rapidly; this should not exceed 5A.

(p) Continue to reduce load resistor value to zero and observe current limit at short circuit. Output current should not exceed 8A and input current should not exceed 1·5A.

(q) Reduce load current to 2A and then vary the PSU voltage over the range 18–32V. The converter output should remain within the range 13·8V ±0·2V.

(r) Switch off the PSU, disconnect all test instruments and reconnect equipment internal leads.

6.7 TRANSMITTER ALIGNMENT

(a) Set the PSU to either 27·6V (24V equipment) or 13·8V (12V equipment) and connect to the in-line fuses (3A/5A respectively).

(b) Connect AF signal generator via 30kΩ resistor to TS1/16 and 17 in control unit (disconnect microphone leads from these terminals). Connect AF millivoltmeter across signal generator output terminals to indicate effective audio input emf from 30kΩ source. *NOTE.* If control unit is supplied with optional 2-pin plug and socket connectors on flying leads, connect the AF signal generator via 30kΩ resistor to the blue coded plug. Connect AF millivoltmeter as described above.

(c) If control unit is supplied with the optional flying lead connectors, a PTT switch must be connected to the red coded socket. If the standard fist microphone with integral PTT switch is supplied, no external PTT connections are necessary.

(d) Disable timer by linking pins 36-35.

(e) Connect VHF power meter/load to the (Tx) antenna socket and connect deviation meter to the attenuated tap on power meter/load.

(f) Switch on and select channel nearest to the mean transmit frequency.

(g) Set the following trimmers to approximately half capacity:
Mid band/high band: C55, C60, C63, C73, C76
Low band: C52, C57, C64, C67, C70.

(h) Operate PTT switch and tune the components listed below (in the order given) for maximum power output. During tuning, adjust potentiometer R155 to keep power below 10W.
Mid band/high band, tune L16, C60, C55, C63, C73, C76.
Low band, tune C52, C57, C64, C67, C70.

(j) When all circuits are on tune, set R155 for maximum power output, which should be greater than 13W.

(k) Check that power output on all other channels is greater than 10W. *NOTE.* Release PTT switch when changing channels.

(l) Connect oscilloscope to deviation meter output to examine the demodulated audio waveform.

(m) Mark the position of preset potentiometer R96. This will normally be fully clockwise, but may have been turned down if a high sensitivity microphone is used in the installation. Turn R96 fully clockwise if not already in this position.

(n) Set AF generator frequency to 1kHz and increase input level until the clipping threshold is reached. Input level should be 60–80mV emf.

(p) Increase input level by 20dB and adjust R119 for a mean positive and negative deviation of 2·2kHz (12·5kHz system) or 4·4kHz (25kHz system).

(q) Reset R96 to its marked position (if applicable).

(r) If the timer function is required in the installation, remove link 36-35. Operate PTT switch and check that power output falls to zero after 90–150 seconds. Power output should be restored by releasing and re-operating the PTT switch.

(s) Switch off the PSU and disconnect all test instruments.

6.8 RF POWER AMPLIFIER TEST

The power amplifier is a wide band module requiring no alignment or adjustment. If necessary the gain may be checked as follows.

(a) Disconnect coaxial leads from pins 1, 2 and 3, 4 on the associated PCB.

(b) Using 50Ω coaxial cable, connect VHF signal generator to pins 2, 1 (pin 1 at 0V) and VHF power meter to pins 4, 3 (pin 3 at 0V).

(c) Switch on, set generator to the mean transmit frequency and adjust level for 12W indicated output.

(d) The input level measured with RF valve voltmeter at pins 2, 1 should be less than 1·8V rms.

(e) Switch off the PSU, disconnect all test instruments and reconnect the coaxial leads to pins 1, 2 and 3, 4.

Note that a mica insulating sheet is used between the module and the heat sink plate. Thermal jointing compound type Thermpath 167 (Redpath Ltd.) is used on all mating surfaces on assembly.

6.9 ANTENNA FILTER TEST

The antenna filter is set up on test for the required band pass response, and no attempt should be made to adjust it. If desired, the filter response may be checked as

indicated in the table below (input and output terminals matched to 50Ω).

	Insertion loss less than 1dB with less than 0·5dB ripple	*Insertion loss greater than 50dB*
Low band	68–88MHz	136–800MHz
Mid band	100–145MHz	210–800MHz
High band	140–180MHz	290–800MHz

6.10 RECEIVER ALIGNMENT

(a) Set the PSU to either 27·6V (24V equipment) or 13·8V (12V equipment) and connect to the in-line fuses (3A/5A respectively).

(b) Connect AF power meter and noise/distortion meter in parallel, to "L/S" terminals in control unit (disconnect loudspeaker leads from these terminals).

(c) Connect VHF signal generator to the (Rx) antenna socket.

(d) Connect AF oscilloscope to pins 32, 31 on receiver board (pin 31 at 0V).

(e) Set volume control to mid position and squelch control fully clockwise.

(f) Switch on and select channel nearest to the mean receive frequency.

(g) Set signal generator to correct frequency, with output level of 100mV emf. Using 1kHz modulation frequency, set deviation to ±1·6kHz/±3·0kHz*.

(h) Tune the components listed below (in the order given) for cleanest audio waveform, reducing RF input level as tuning proceeds.
Mid band/high band, tune C15, C9, C7, C3, C2, C8, C20, C21, C23, T2, T3.
Low band, tune C15, L9, L7, L5, L3, L2, C20, C21, C23, T2, T3.

(j) Increase deviation to ±2·5kHz/±5·0kHz* and adjust C15, T2, T3, T6, L13 for best audio waveform with RF input of 1μV emf.

(k) Reduce deviation to ±0·8kHz/±1·6kHz* and increase RF input level to 1mV emf.

(l) Connect oscilloscope across "L/S" terminals in control unit. Turn volume control fully clockwise and adjust R93 until oscilloscope indicates just below clipping; power output should be greater than 2W.

(m) Increase deviation to ±1·6kHz/±3·0kHz* and decrease RF input level to 1·0μV emf. Check that SINAD ratio is better than 12dB on all channels.

(n) Adjust squelch control so that receiver is just muted with no signal input. Check that squelch opens at less than 0·7μV emf on all channels.

(p) Switch off the PSU, disconnect all test instruments and reconnect the loudspeaker leads.

*Deviation figures given refer to 12·5kHz system/25kHz system respectively.

7 COMMISSIONING NEW CHANNEL(S)

7.1 ORDERING CHANNEL CRYSTALS

7.2 FITTING CRYSTALS

7.3 SETTING UP CHANNEL(S)
- 7.3.1 Test Equipment Required
- 7.3.2 Receiver Adjustment
- 7.3.3 Transmitter Adjustment

7 COMMISSIONING NEW CHANNEL(S)

7.1 ORDERING CHANNEL CRYSTALS

The MRT12 transceiver is normally dispatched from the factory equipped with the customer's specified channel crystals. If it is desired to make alterations or additions to the channels in use, additional crystals will be necessary (one transmitter crystal and one receiver crystal per channel).

NOTES.

1. For maximum no. of channels which can be accommodated, refer to Table 1.1.

2. Minimum channel spacing may be either 12·5kHz or 25kHz (also shown in Table 1.1).

3. Transmit and receive frequencies of new channels must lie within 1% of the transmit and receive frequencies of channels already fitted.

4. The standard extended control unit is fitted with a 12 position Channel switch, but only positions 1–4 select channel crystals in 4 channel versions of the transceiver. In the single channel version, the Channel switch wiring is not connected at the transceiver.

Channel crystals for this equipment are obtainable from Redifon Telecommunications Ltd. The order should state the following:

(a) Type and serial number of the equipment as shown on the transceiver label.

(b) Modification state of the equipment as shown on the Mod. Record label.

(c) Style J crystal to Redifon specification P37288/S.

(d) Transmitter crystal frequency, calculated as shown below:
Low band MRT12LB: Tx crystal frequency = T ÷ 3
Mid band MRT12MB: Tx crystal frequency = T ÷ 4
High band MRT12HB: Tx crystal frequency = T ÷ 6
where T = channel transmit frequency.

(e) Receiver crystal frequency, calculated as shown below:
Low band MRT12LB:
Rx crystal frequency = (R − 10·7MHz) ÷ 2
Mid band MRT12MB:
Rx crystal frequency = (R − 10·7MHz) ÷ 4
High band MRT12HB:
Rx crystal frequency = (R − 10·7MHz) ÷ 4
where R = channel receive frequency.

7.2 FITTING CRYSTALS

Disconnect the battery supply and antenna(e) from the transceiver. Remove the transceiver from its mounting frame and open up the unit to expose the printed circuit boards, taking care to avoid damaging any components.

Locate the transmitter board (module 3) and solder the transmitter crystal into the required channel position. Solder the receiver crystal into the same channel position on the receiver board (module 6). *CAUTION.* When soldering channel crystals avoid the use of excessive heat.

Reconnect the supply, switch on and select the new channel. Allow the unit temperature to stabilise for a few minutes before making the frequency adjustments.

7.3 SETTING UP CHANNEL(S)

7.3.1 Test Equipment Required

Frequency counter 41MHz, e.g. Advance TC17
RF valve voltmeter e.g. Dymar 1711
VHF power meter/load 50Ω, 20W.

7.3.2 Receiver Adjustment

(a) Connect frequency counter and valve voltmeter to pins 34, 33 on receiver board (pin 33 at 0V).

(b) If new channel is in group 1–4, adjust trimmer C62 (if necessary) for valve voltmeter readings as near equal as possible on the four channels; these readings should be greater than 400mV. For groups 5–8 or 9–12 (12 channel versions only) adjust C63 or C64 as necessary. *NOTE.* In low band and high band versions, where C50–C61 are trimmers, it may be necessary to make an initial adjustment to the appropriate trimmer (see table) before the oscillator will start.

(c) Tune to the correct crystal frequency, within ±5Hz, by means of successive adjustments to the variable inductor and trimmer (if fitted) shown in the table overleaf.

Receiver Adjustments (Module 6)

Channel no.		*1 2 3 4*	*5 6 7 8*	*9 10 11 12*
Adjust for equal VVM readings		← C62 →	← C63 →	← C64 →
Adjust for correct freq. ±5Hz	Inductor	L14 L15 L16 L17	L18 L19 L20 L21	L22 L23 L24 L25
	Trimmer*	C50 C51 C52 C53	C54 C55 C56 C57	C58 C59 C60 C61

*In mid band versions, 10pF fixed capacitors are fitted in positions C50–C61.

7.3.3 Transmitter Adjustment

(a) Connect VHF power meter/load to (Tx) antenna socket and operate the PTT switch. Allow the unit temperature to stabilise for a few minutes before making the frequency adjustments. *NOTE.* If the PTT timer is operative, it will be necessary to release and re-operate the PTT switch each time the transmitter switches off, i.e. approximately every 2 minutes. Alternatively, a temporary croc-clip lead may be linked between pins 36 and 35 (0V) on the transmitter board to override the timer function; this link must be removed on completion of the adjustments.

(b) Connect frequency counter and valve voltmeter to pins 26, 25 on transmitter board (pin 25 at 0V).

(c) If new channel is in group 1–4, adjust trimmer C21 (if necessary) for valve voltmeter readings as near equal as possible on the four channels: these readings should be greater than 400mV. For groups 5–8 or 9–12 (12 channel versions only) adjust C22 or C23 as necessary. *NOTE.* In low band and high band versions, where C9–C20 are trimmers, it may be necessary to make an initial adjustment to the appropriate trimmer (see table) before the oscillator will start.

(d) Tune to the correct crystal frequency, within ±5Hz, by means of successive adjustments to the variable inductor and trimmer (if fitted) shown in the table below.

(e) On completion of these adjustments, disconnect the test instruments and the battery supply from the transceiver.

(f) Refit the transceiver into its case, taking care to avoid damaging any components.

(g) Refit the unit into its mounting frame, and finally reconnect the supply and antenna(e) to the transceiver.

Transmitter Adjustments (Module 3)

Channel no.		*1 2 3 4*	*5 6 7 8*	*9 10 11 12*
Adjust for equal VMM readings		← C21 →	← C22 →	← C23 →
Adjust for correct freq. ±5Hz	Inductor	L1 L2 L3 L4	L5 L6 L7 L8	L9 L10 L11 L12
	Trimmer*	C9 C10 C11 C12	C13 C14 C15 C16	C17 C18 C19 C20

*In mid band versions, 10pF fixed capacitors are fitted in positions C9–C20.

8 ILLUSTRATIONS & COMPONENT LISTS

TRANSCEIVER MAINFRAME (MODULE 1)

Fig. 8.1 Location of Major Components in Transceiver
- **(a) Front View**
- **(b) Rear View**
- **8.1.1 Transceiver Miscellaneous Component List**

Fig. 8.2 Transceiver Overall Circuit Diagrams
- **(a) Two Antenna Version**
- **(b) Single Antenna 24V Version**
- **(c) Single Antenna 12V Version**

DC INPUT CIRCUITS (MODULE 2)

Fig. 8.3 DC-DC Converter Layouts
- **(a) Control PCB Layout**
- **(b) Switching PCB Layout**
- **8.3.1 Control PCB Component List**
- **8.3.2 Switching PCB Component List**

Fig. 8.4 DC-DC Converter Circuit

Fig. 8.5 12V Input Protection PCB Layout
- **8.5.1 12V Input Protection PCB Component List**

Fig. 8.6 12V Input Protection PCB Circuit

TRANSMITTER PCB (MODULE 3)

Fig. 8.7 Transmitter PCB Layouts
- **(a) Mid Band/High Band Versions**
- **(b) Low Band Version**
- **8.7.1 Mid Band/High Band Transmitter PCB Component List**
- **8.7.2 Low Band Transmitter PCB Component List**

Fig. 8.8 Transmitter PCB Circuits
- **(a) Mid Band/High Band Versions**
- **(b) Low Band Version**

PA & ANTENNA FILTER (MODULES 4 & 5)

Fig. 8.9 PA & Antenna Filter Layouts
- **(a) Power Amplifier Assembly Layout**
- **(b) Antenna Filter Layout**
- **(c) PA & Antenna Filter Assembly Layout**
- **8.9.1 Power Amplifier Component List**
- **8.9.2 Antenna Filter Component List**
- **8.9.3 Antenna Switch Component List**

Fig. 8.10 PA & Antenna Filter Circuits
- **(a) Power Amplifier Circuit**
- **(b) Antenna Filter Circuit**

RECEIVER (MODULE 6)

Fig. 8.11 Receiver PCB Layouts
- **(a) Mid Band/High Band Versions**
- **(b) Low Band Version**
- **8.11.1 Mid Band/High Band Receiver PCB Component List**
- **8.11.2 Low Band Receiver PCB Component List**

Fig. 8.12 Rx Multiplier PCB Layouts
(a) Mid Band/High Band Versions
(b) Low Band Version
8.12.1 Mid Band/High Band Rx Multiplier PCB Component List
8.12.2 Low Band Rx Multiplier PCB Component List
Fig. 8.13 Receiver Circuits
(a) Mid Band/High Band Versions
(b) Low Band Version

EXTENDED CONTROL UNIT (MODULE 7)
Fig. 8.14 Location of Major Components in Extended Control Unit
(a) Rear View with Cover Removed
(b) View with Terminal Panel Removed
8.14.1 Extended Control Unit Component List
Fig. 8.15 Extended Control Unit Circuit

Fig. 8.12 Rx Multiplier PCB Layouts
(a) Mid Band/High Band Versions
(b) Low Band Version
8.12.1 Mid Band/High Band Rx Multiplier PCB Component List
8.12.2 Low Band Rx Multiplier PCB Component List
Fig. 8.13 Receiver Circuits
(a) Mid Band/High Band Versions
(b) Low Band Version

EXTENDED CONTROL UNIT (MODULE 7)

Fig. 8.14 Location of Major Components in Extended Control Unit
(a) Rear View with Cover Removed
(b) View with Terminal Panel Removed
8.14.1 Extended Control Unit Component List
Fig. 8.15 Extended Control Unit Circuit

8.1.1 Transceiver Miscellaneous Component List

RESISTOR

R1 4·7kΩ ±5% 0·33W Mullard CR25

FERRITE BEAD

FB1 B62110-A6021-X001 Siemens

TERMINAL STRIPS

TS1 L1794A (12 way) Belling Lee, 2 1/3 off

Rx ANTENNA SOCKET
(fitted to 2-antenna equipments only)*

SK1 50Ω BNC Greenpar GE35006G

FLYING LEAD CONNECTORS

35-way socket 74/10/3502/10 Plessey

Fuseholders 20/459 Pressac (2 off)

Fuses FS1, FS2:
24V: L1055/3A fast blow, Belling Lee
12V: L1055/5A fast blow, Belling Lee
Fuse dimensions 32mm x 6·3mm (1¼ in x ¼ in)

*NOTE Details of the antenna switch circuit fitted to single antenna equipments are given in Component List 8.9.3.

1

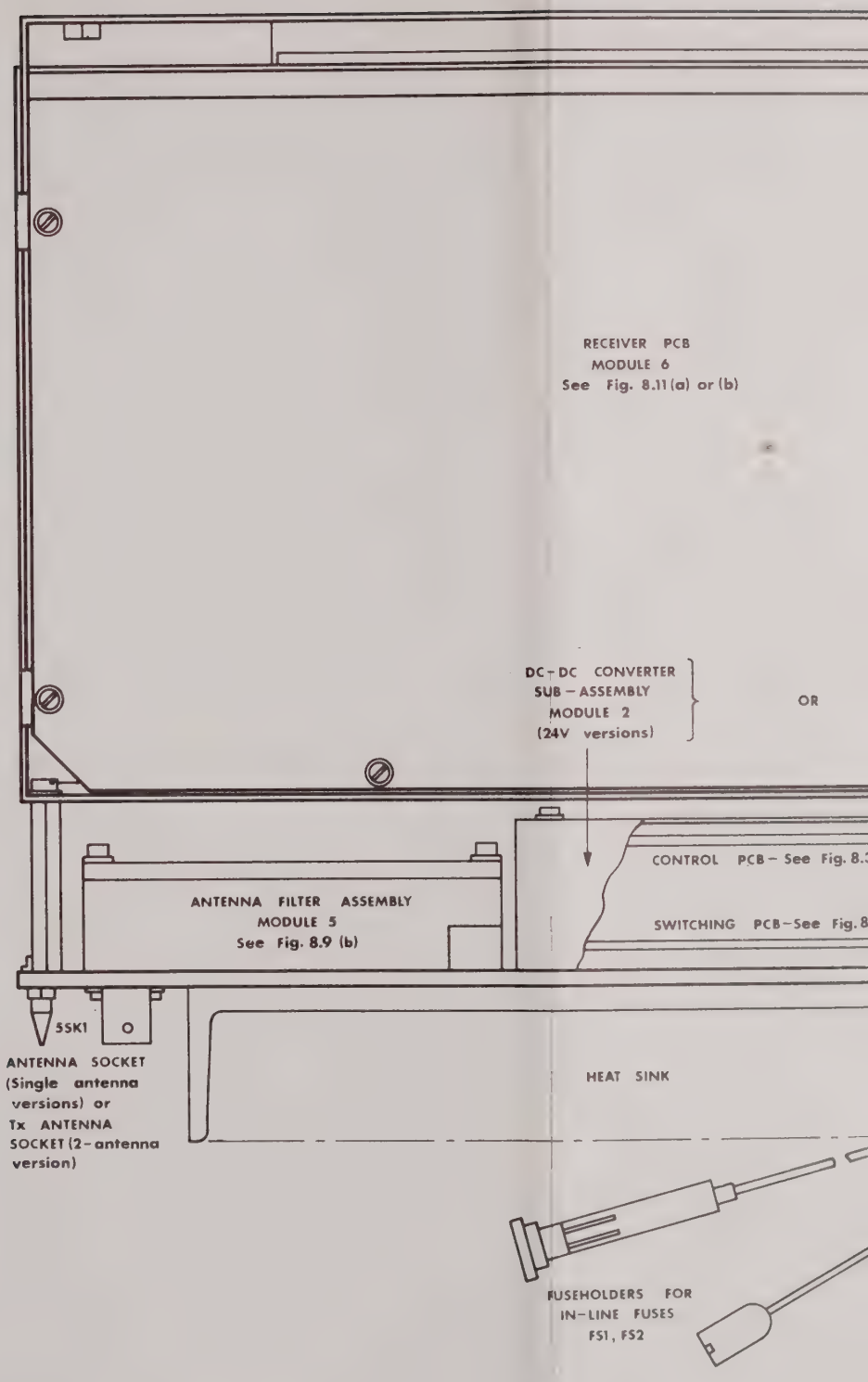


Fig.8.1(a) Front View

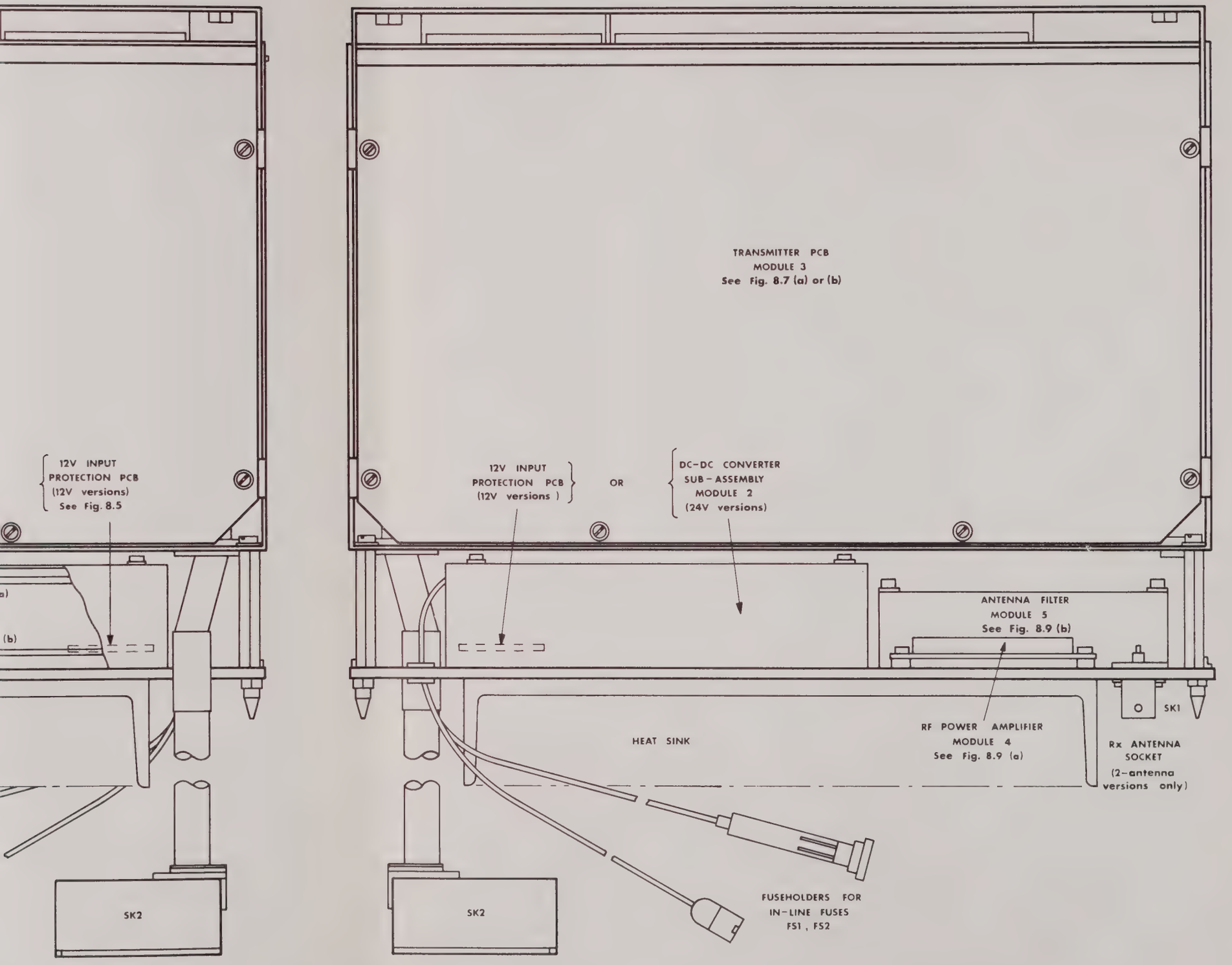
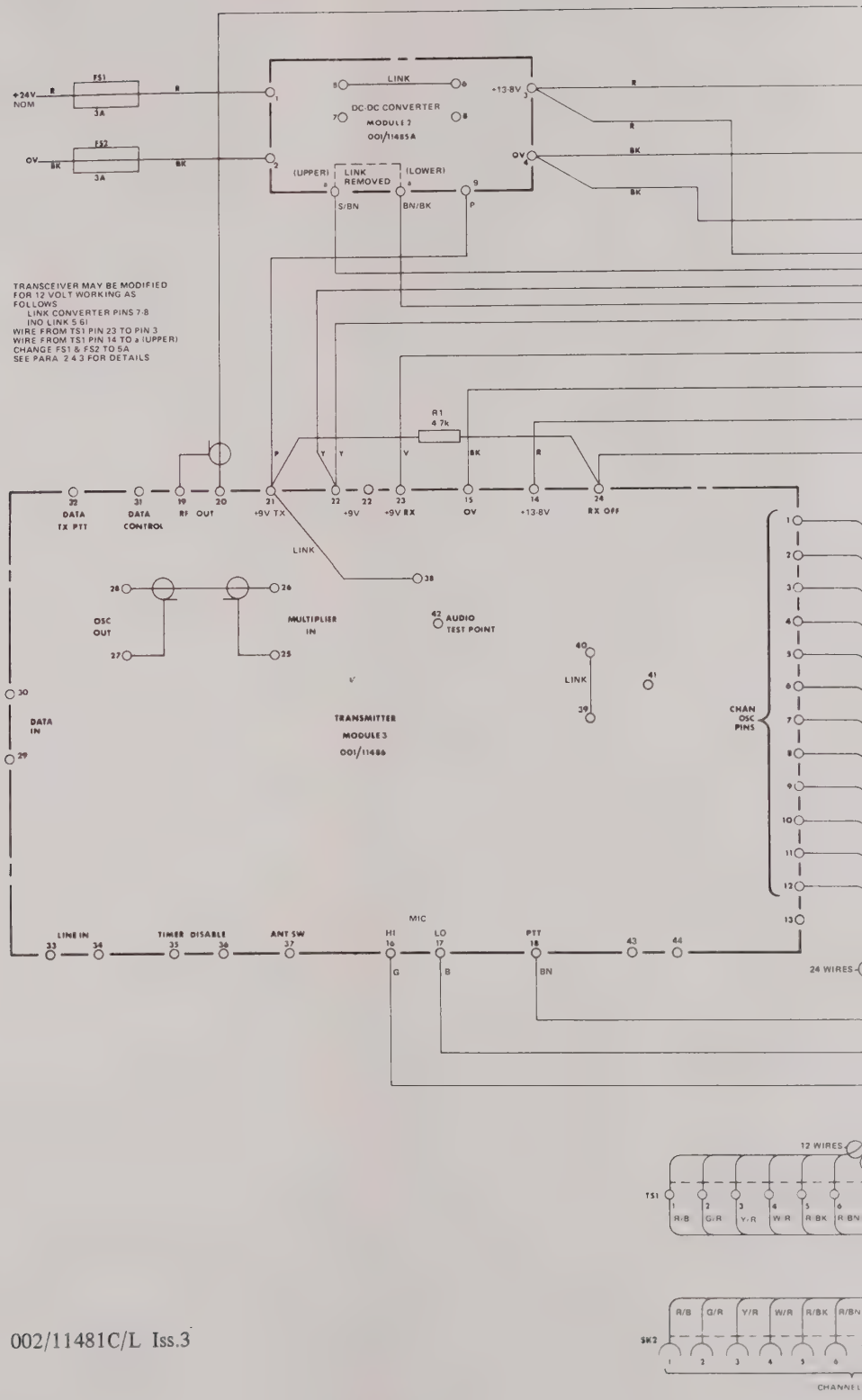
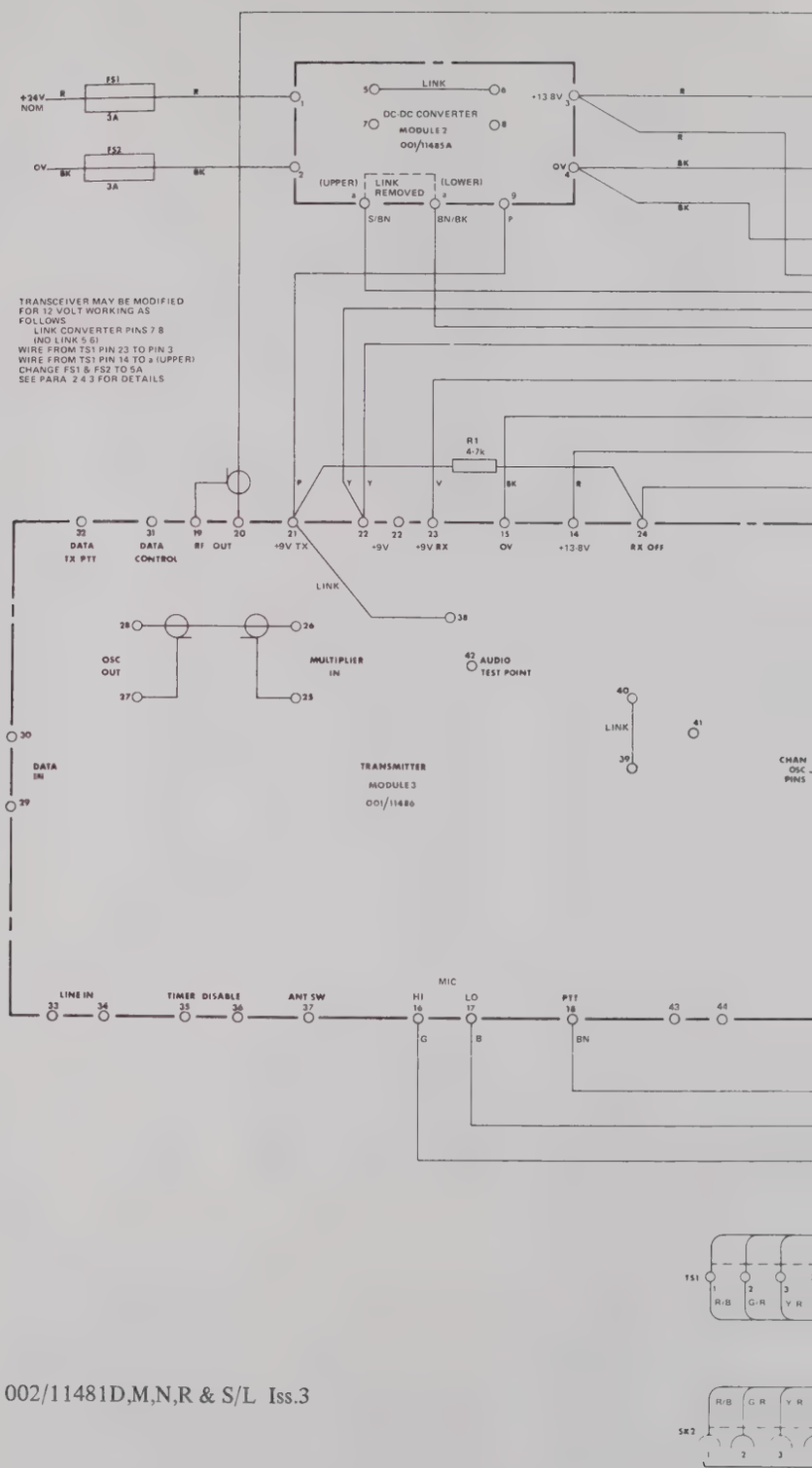
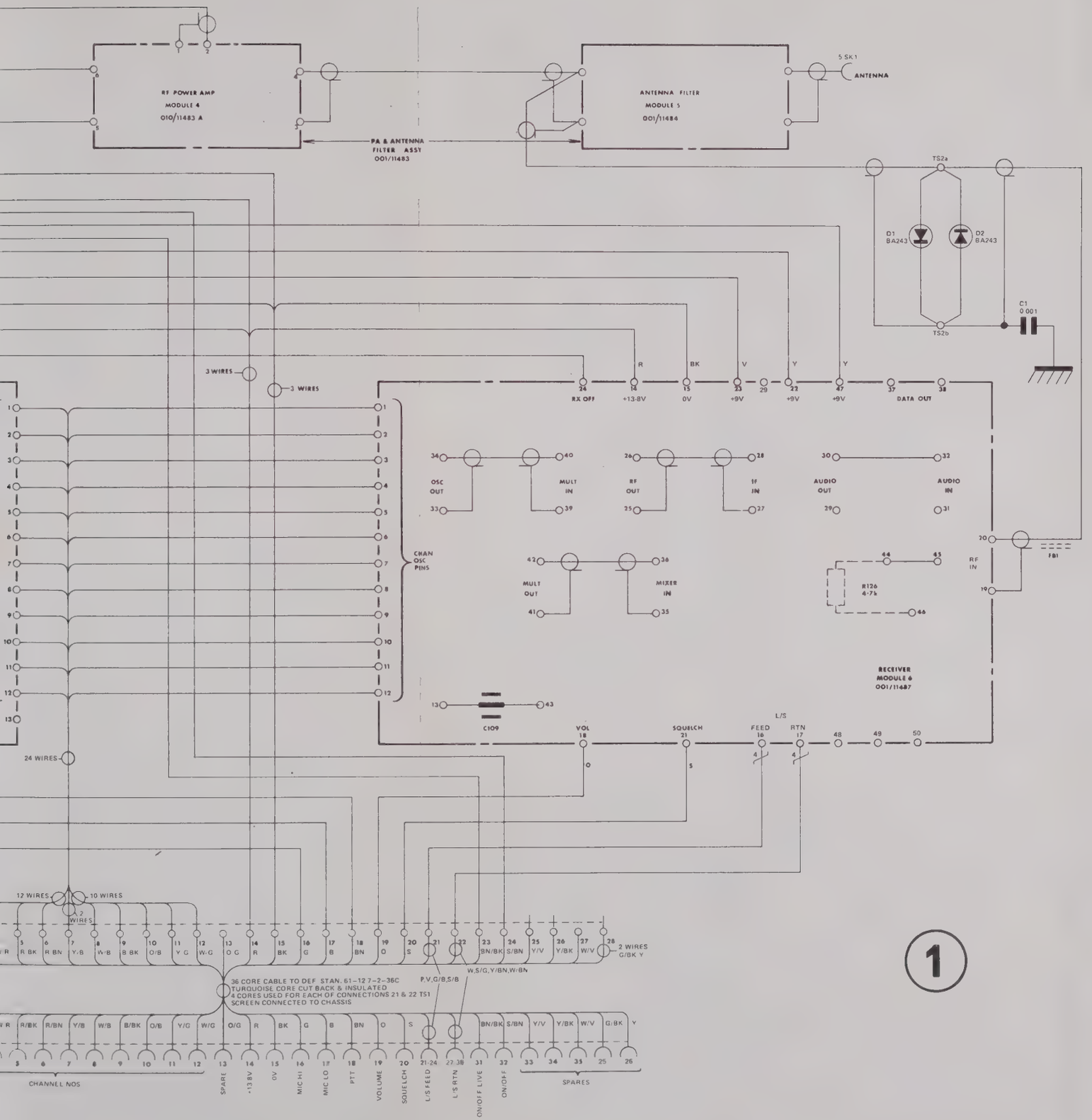


Fig.8.1(b) Rear View



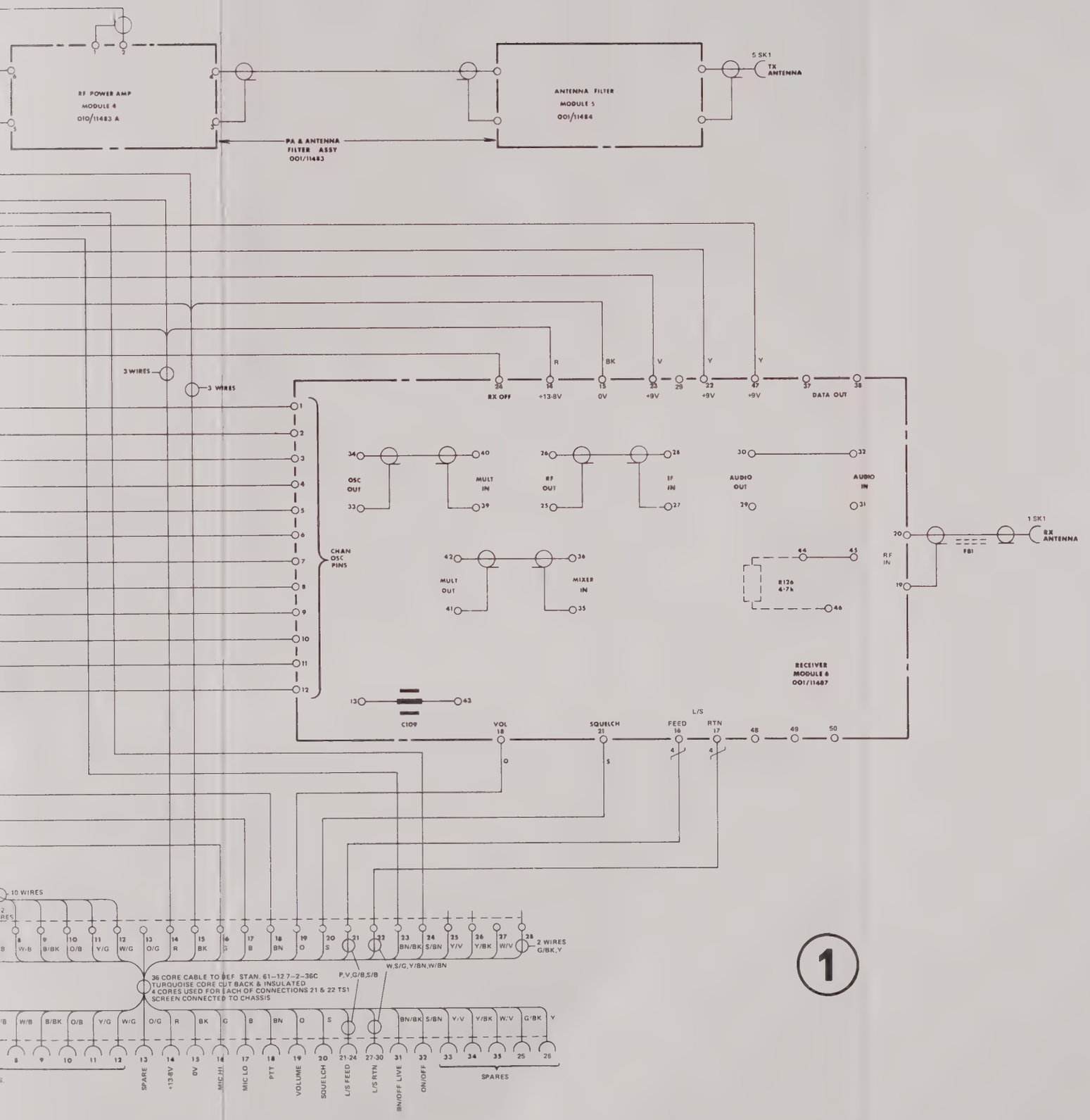
002/11481C/L Iss.3


+24V NOM
FS1
3A
0V
FS2
3A
DC-DC CONVERTER
MODULE 2
001/11485A
LINK
+13.8V
(UPPER)
LINK REMOVED
(LOWER)
S/BN
BN/BK
P
TRANSCEIVER MAY BE MODIFIED FOR 12 VOLT WORKING AS FOLLOWS
LINK CONVERTER PINS 7 8 (NO LINK 5 6)
WIRE FROM TS1 PIN 23 TO PIN 3
WIRE FROM TS1 PIN 14 TO a (UPPER)
CHANGE FS1 & FS2 TO 5A
SEE PARA 2 4 3 FOR DETAILS
R1
4·7k
DATA TX PTT
DATA CONTROL
RF OUT
+9V TX
+9V
+9V RX
0V
+13·8V
RX OFF
LINK
OSC OUT
MULTIPLIER IN
AUDIO TEST POINT
LINK
DATA IN
TRANSMITTER
MODULE 3
001/11486
CHAN OSC PINS
MIC
LINE IN
TIMER DISABLE
ANT SW
HI
LO
PTT
TS1
SK2



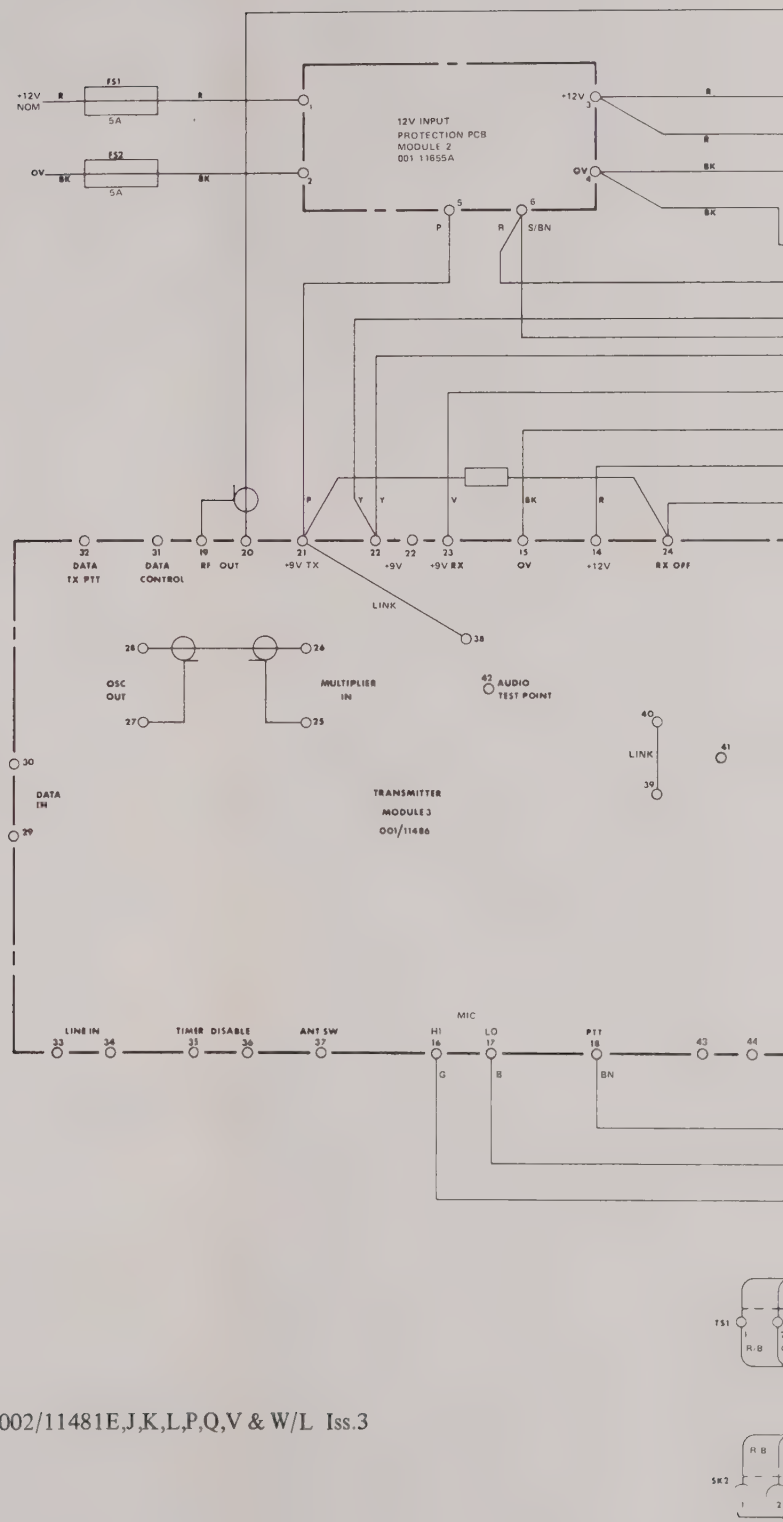
1

TRANSCEIVER OVERALL CIRCUIT – SINGLE ANTENNA 24V VERSION FIG.8.2(b)

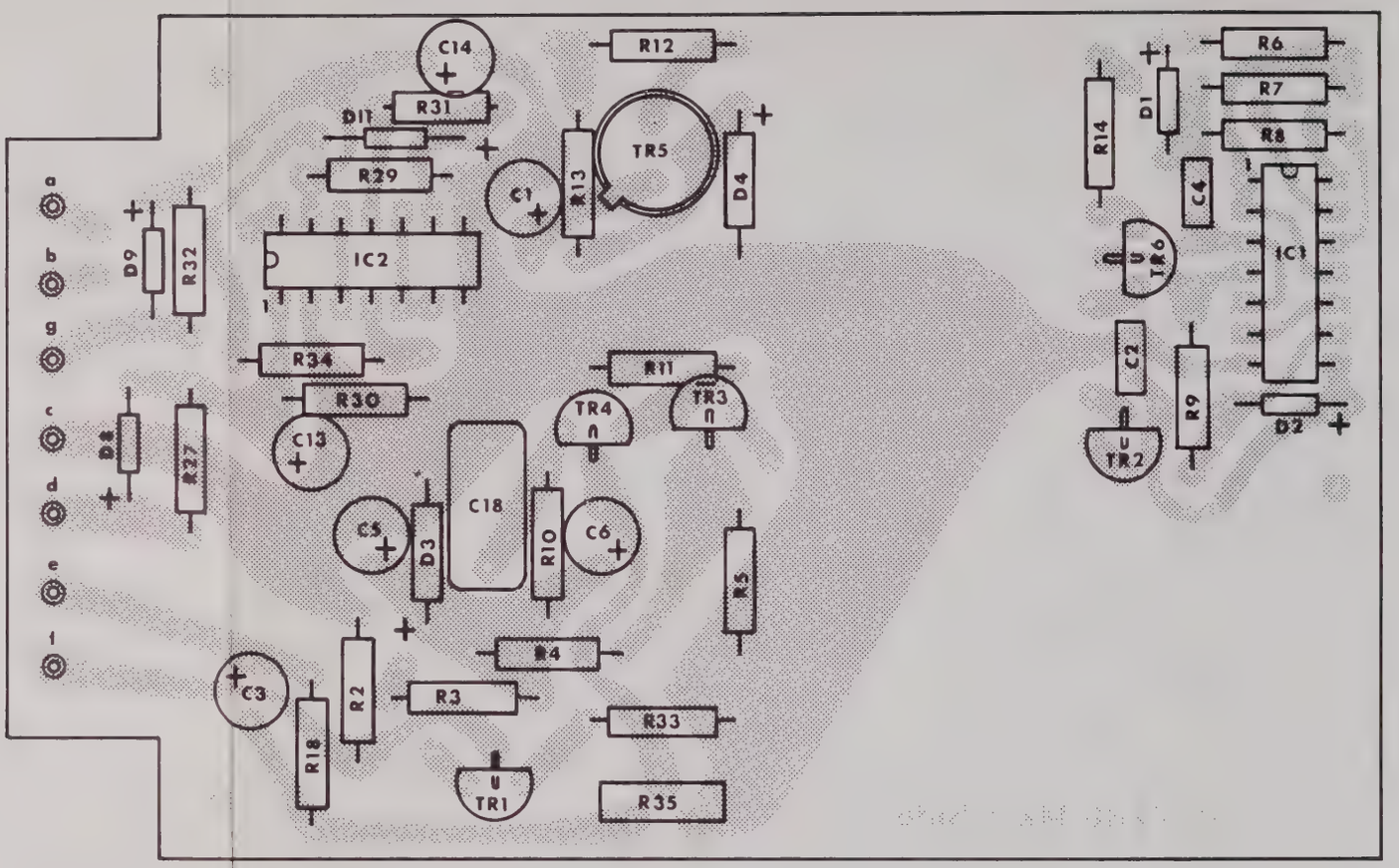


1

TRANSCEIVER OVERALL CIRCUIT – TWO ANTENNA VERSION FIG.8.2(a)



002/11481E,J,K,L,P,Q,V & W/L Iss.3



012/11485A/2 Iss.1

Fig.8.3(a) Control PCB Layout

8.3.1 Control PCB Component List

NOTE This PCB (part of DC-DC converter) is fitted only in 24V versions of the equipment.

RESISTORS

Unless otherwise stated, all resistors are ±5% 0·33W Mullard CR25

R2	10kΩ
R3	330Ω
R4	6·8kΩ
R5	6·8kΩ
R6	5·6kΩ
R7	68kΩ
R8	100kΩ
R9	220kΩ
R10	100Ω
R11	330Ω
R12	180Ω
R13	3·3kΩ
R14	1·5kΩ
R18	2·2kΩ
R27	10kΩ
R29	100kΩ
R30	47kΩ
R31	150kΩ
R32	10kΩ
R33	330Ω
R34	47kΩ
R35	1kΩ 0·5W LIN Potentiometer Morganite 90V

CAPACITORS

C1	4·7μF ±20% 16V ITT TAG4·7M16
C2	47pF ±2% 63V Mullard C333CC
C3	10μF ±20% 16V ITT TAG10M16
C4	100pF ±2% 63V Mullard C333CC
C5	10μF ±20% 16V ITT TAG10M16
C6	100μF ±20% 3V ITT TAG100M3
C13	4·7μF ±20% 16V ITT TAG 4·7M16
C14	10μF ±20% 16V ITT TAG10M16
C18	0·1μF ±20% 100V ITT PMT2R

DIODES

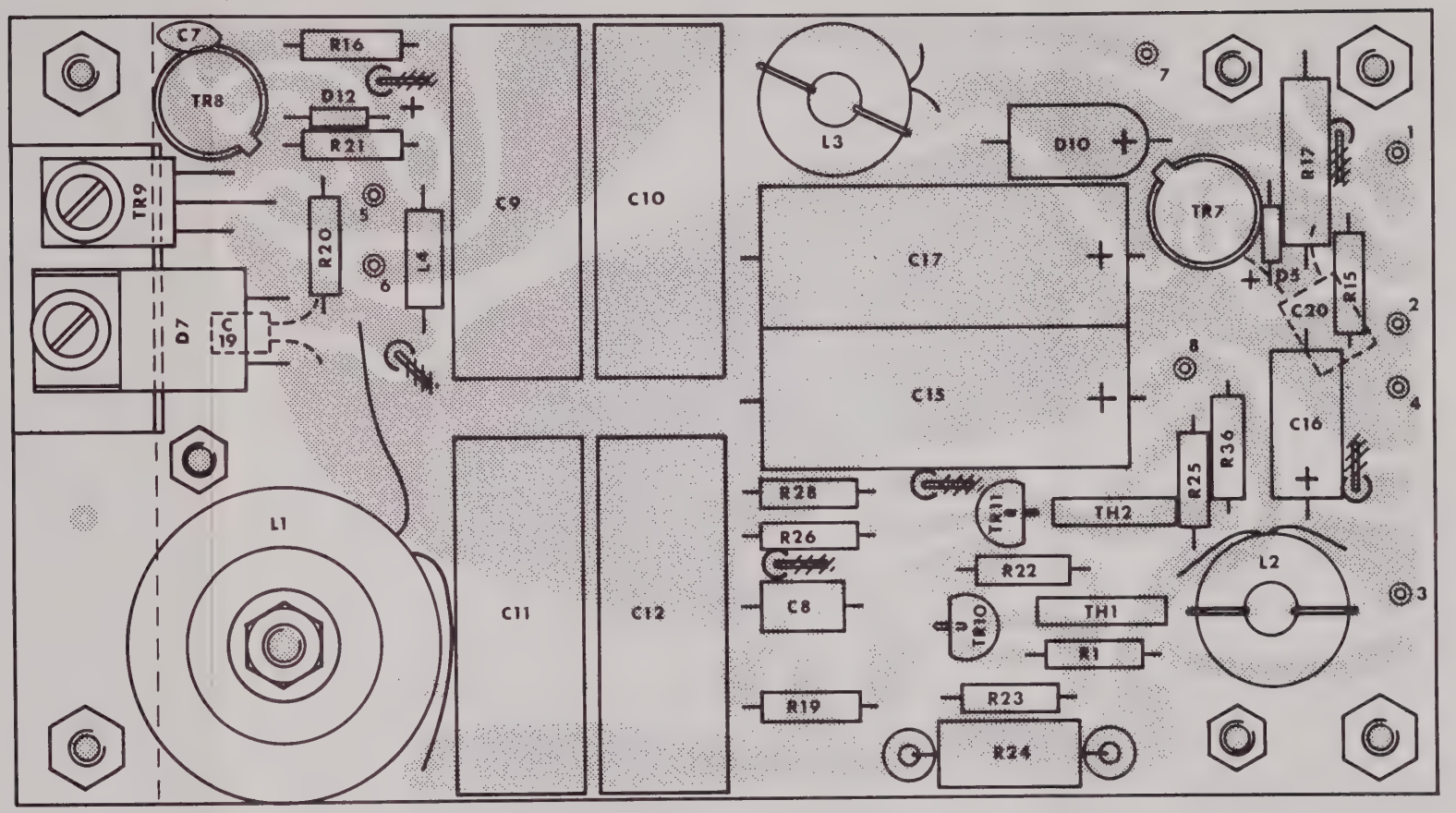
D1	1N4148 ITT
D2	1N4148 ITT
D3	Zener BZY88C4V7 Mullard
D4	Zener BZY88C10 Mullard
D8	1N4148 ITT
D9	1N4148 ITT
D11	1N4148 ITT

TRANSISTORS

TR1	2N3904 Motorola
TR2	2N3904 Motorola
TR3	2N3904 Motorola
TR4	3N3906 Motorola
TR5	2N3053 Motorola
TR6	2N3904 Motorola

INTEGRATED CIRCUITS

IC1	MC14001 Motorola
IC2	MC14001 Motorola



010/11485A/2 Iss.5

Fig.8.3(b) Switching PCB Layout

8.3.2 Switching PCB Component List

NOTE This PCB (part of DC-DC converter) is fitted only in 24V versions of the equipment.

RESISTORS

Unless otherwise stated, all resistors are ±5% 0·33W Mullard CR25

R1	1kΩ
R15	180Ω
R16	100Ω
R17	1kΩ ±5% 1W Electrosil TR6
R19	1kΩ
R20	68Ω
R21	2·2Ω
R22	270Ω
R23	560Ω
R24	0·15Ω ±5% 2·5W Welwyn W21
R25	12kΩ
R26	330kΩ
R28	10kΩ
R36	18kΩ

THERMISTORS

TH1	1·3kΩ nominal, 1W Mullard VA1038
TH2	1·3kΩ nominal, 1W Mullard VA1038

CAPACITORS

C7	27pF ±2% 63V Mullard C333CC
C8	0·001μF ±2·5% 63V Suflex HS
C9	10μF ±10% 63V Advance MF1MD50
C10	10μF ±10% 63V Advance MF1MD50
C11	10μF ±10% 63V Advance MF1MD50
C12	10μF ±10% 63V Advance MF1MD50
C15	220μF 25V Mullard 017-16221
C16	22μF 25V Mullard 015-16229
C17	150μF 40V Mullard 017-17151
C19*	0·01μF 40V Mullard 629-02103
C20*	120pF ±2% 63V Mullard C333CC

* May not be fitted on early equipments

INDUCTORS

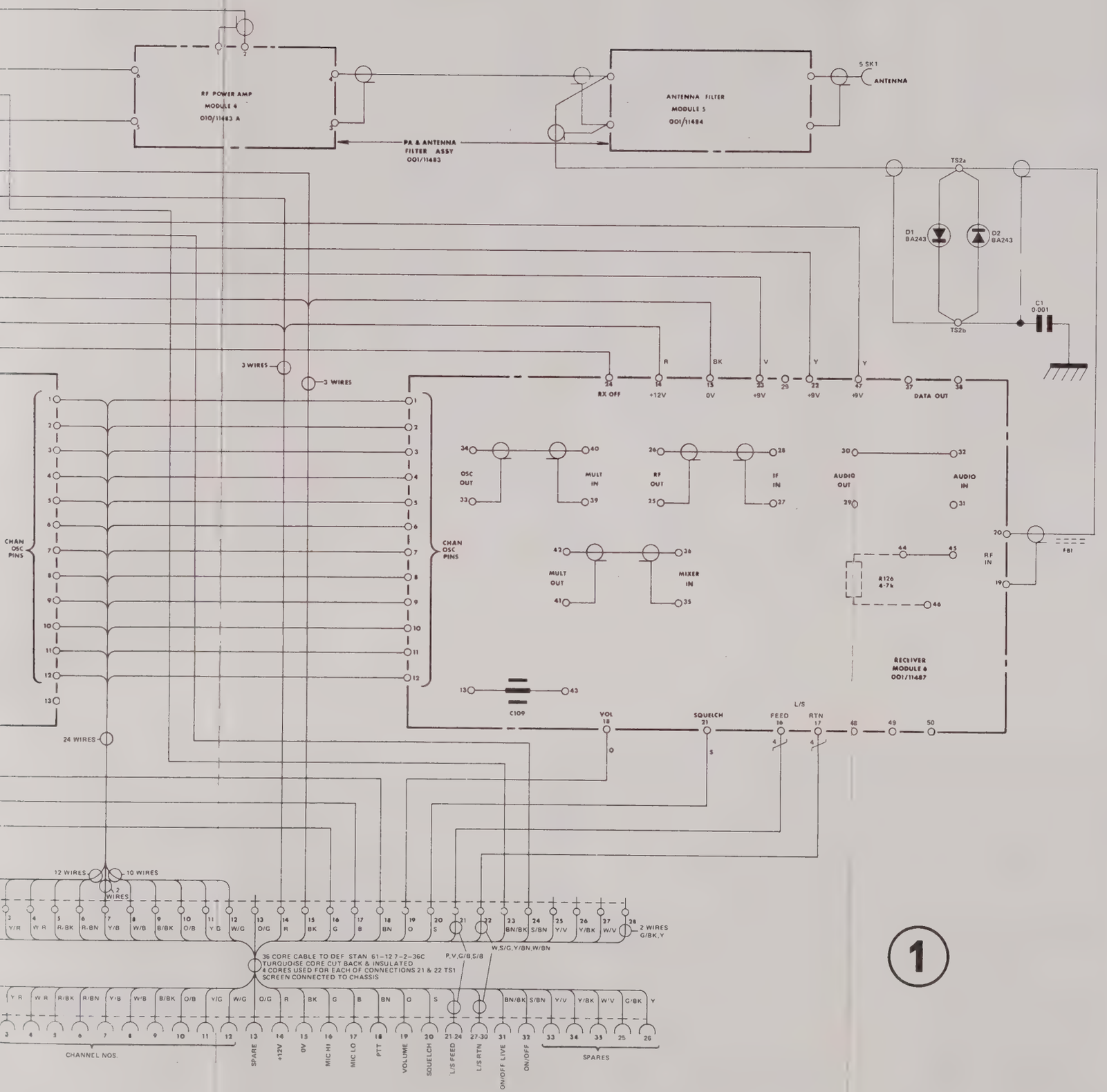
L1	P44521/S Redifon
L2	P29681/S Redifon
L3	P29681/S Redifon
L4	10μH Plessey 58/10/0011/10

DIODES

D5	AAZ15 Mullard
D7	XF6/1 Remo or EF100M3 Westinghouse
D10	Surge Suppressor BZW70-33 Mullard
D12	AAZ15 Mullard

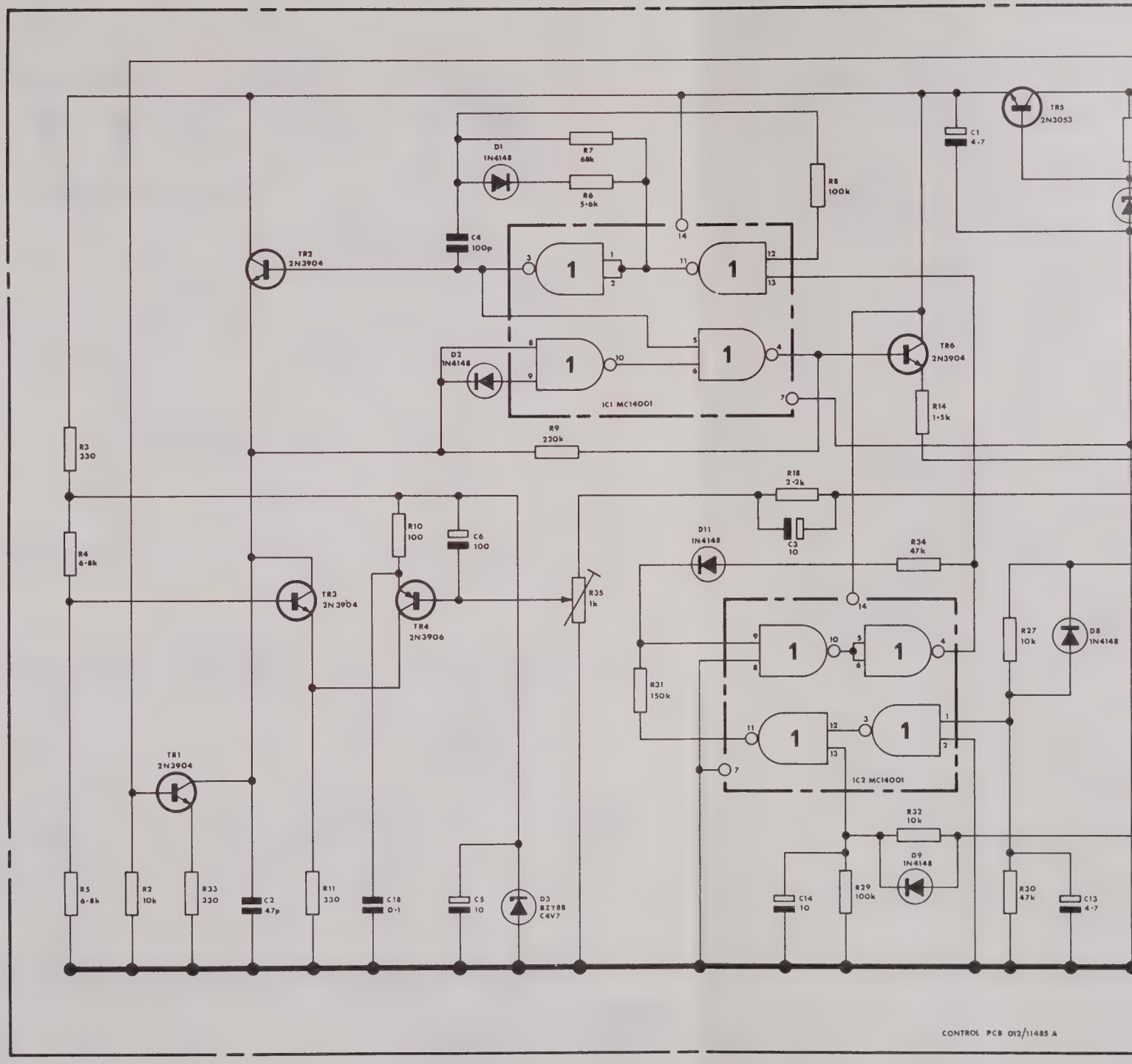
TRANSISTORS

TR7	BSV64 Mullard
TR8	BFT36 Texas
TR9	BDX35 Mullard
TR10	2N3906 Motorola
TR11	2N3906 Motorola



1

TRANSCEIVER OVERALL CIRCUIT – SINGLE ANTENNA 12V VERSION FIG.8.2(c)



002/11485A/X Iss.3

DC INPUT 18–30V + –

8.5.1 Protection PCB Component List

NOTE This PCB is fitted only in 12V versions of the equipment.

CAPACITORS

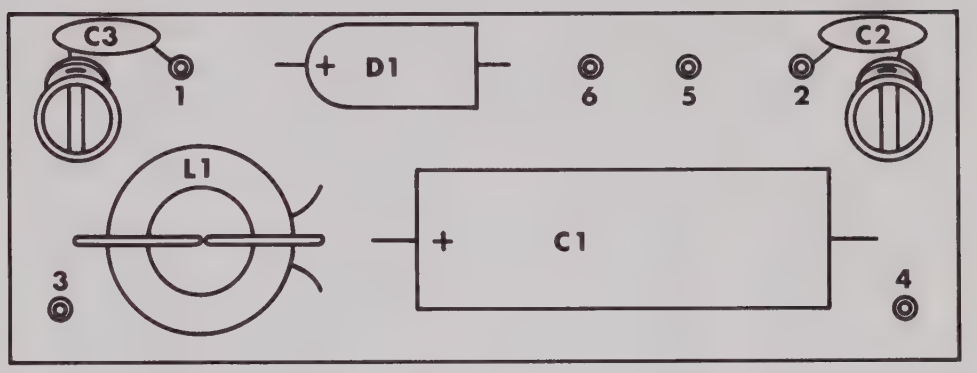
C1	220μF 25V Mullard 017-16221
C2	0·01μF 250V Erie 801-K800011
C3	0·01μF 250V Erie 801-K800011

INDUCTOR

L1	P29681/3 Redifon

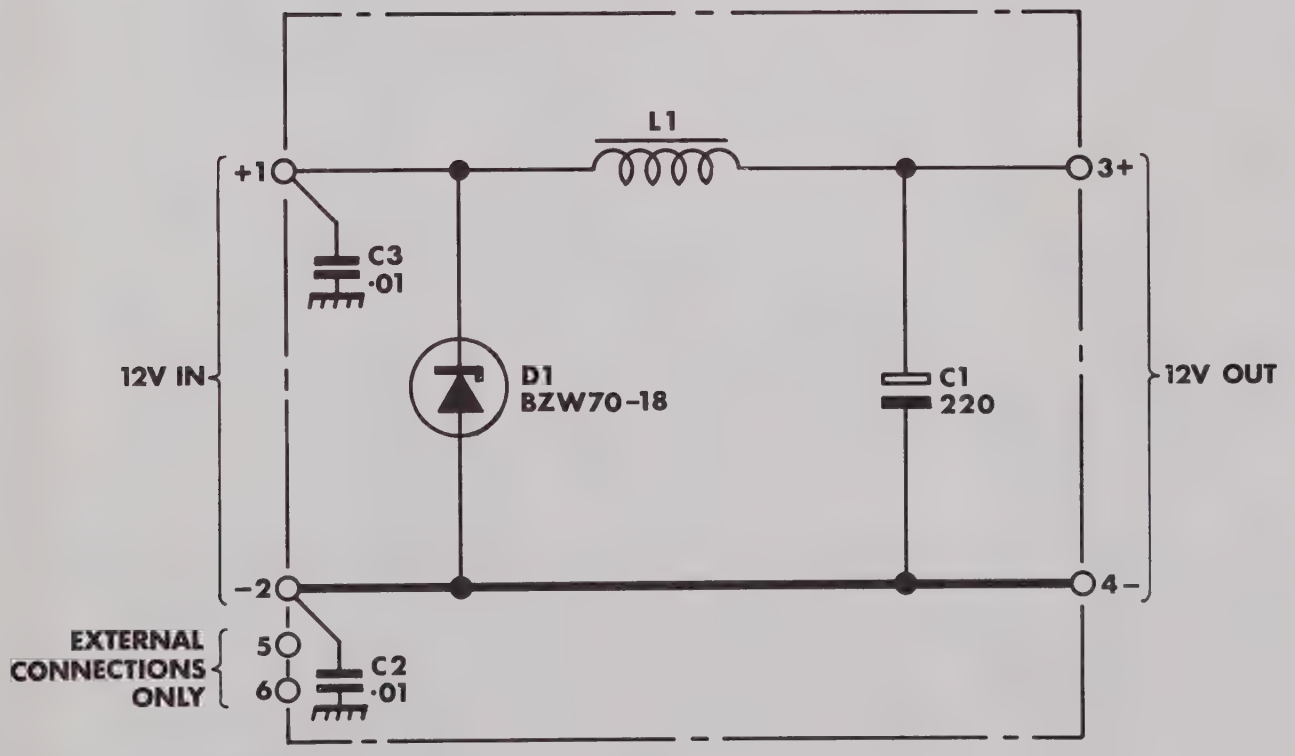
DIODE

D1	Surge Suppressor BZW70-18 Mullard



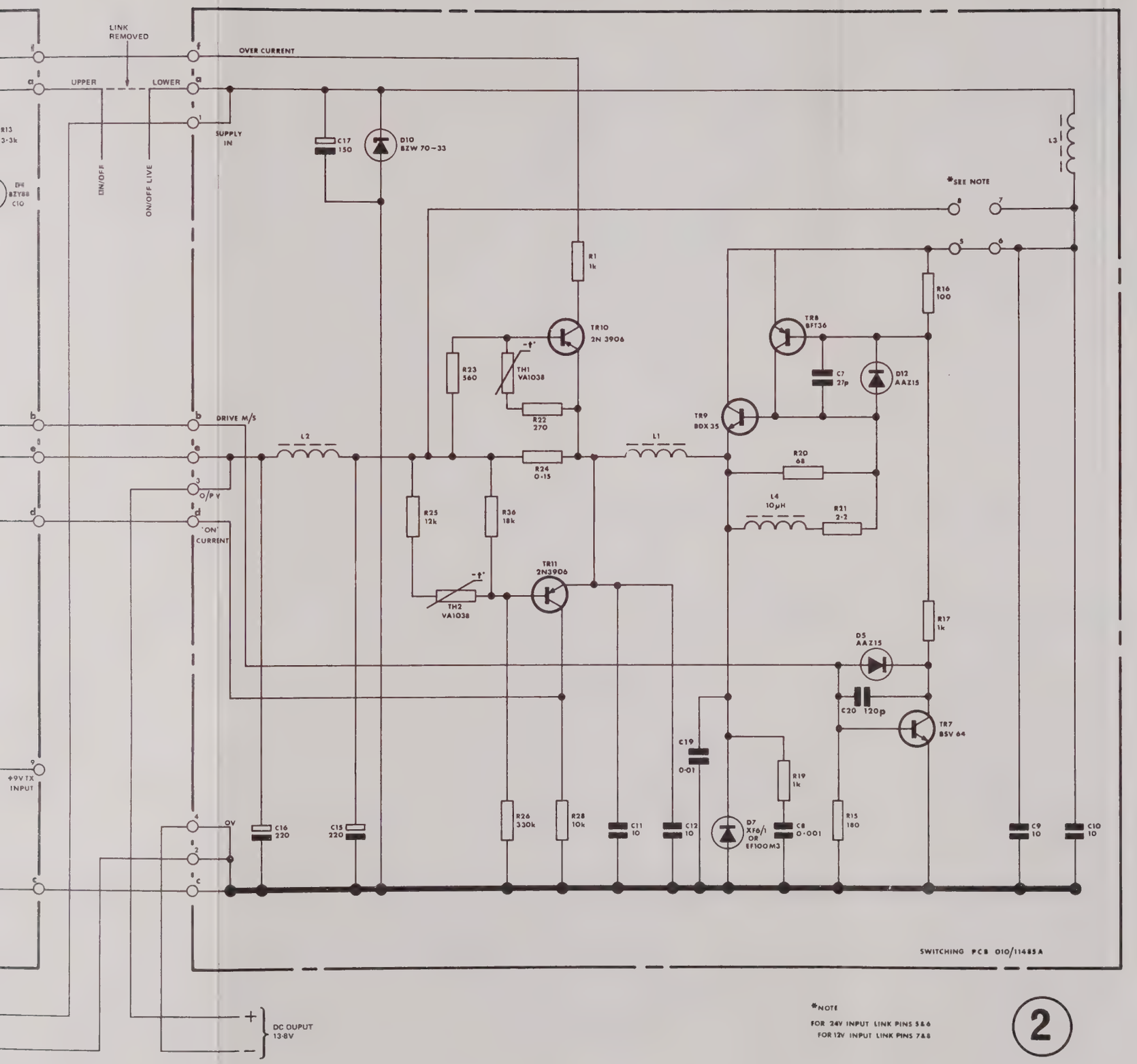
001/11655A/2 Iss.2

Fig.8.5 Protection PCB Layout



002/11655A/S Iss.2

Fig.8.6 Protection PCB Circuit



DC-DC CONVERTER CIRCUIT FIG.8.4

8.7.1 Mid Band/High Band Transmitter PCB Component List

NOTE All components are prefixed as shown below to indicate in which versions of the equipment they are fitted:

–all–:	fitted in 12 channel, 4 channel & single channel versions.
12 & 4 ch.:	fitted in 12 channel & 4 channel versions.
12 ch. only:	fitted in 12 channel versions only.
M/B only:	fitted in mid band versions only.

RESISTORS

Commonly used resistors are identified as follows:
(i) ±5% 0·33W Mullard CR25
(ii) ±2% 0·25W Electrosil TR4

R1	–all–	6·8kΩ (i)
R2	–all–	2·2kΩ (i)
R3	–all–	68Ω (i)
R4	–all–	4·7kΩ (i)
R5	12 ch. only	4·7kΩ (i)
R6	12 ch. only	4·7kΩ (i)
R7	–all–	4·7kΩ (i)
R8	12 ch. only	4·7kΩ (i)
R9	12 ch. only	4·7kΩ (i)
R10	–all–	1kΩ (i)
R11	12 ch. only	1kΩ (i)
R12	12 ch. only	1kΩ (i)
R13	–all–	330Ω (i)
R14	12 & 4 ch.	330Ω (i)
R15	12 & 4 ch.	330Ω (i)
R16	12 & 4 ch.	330Ω (i)
R17	12 ch. only	330Ω (i)
R18	12 ch. only	330Ω (i)
R19	12 ch. only	330Ω (i)
R20	12 ch. only	330Ω (i)
R21	12 ch. only	330Ω (i)
R22	12 ch. only	330Ω (i)
R23	12 ch. only	330Ω (i)
R24	12 ch. only	330Ω (i)
R25	–all–	1kΩ (i)
R26	12 & 4 ch.	1kΩ (i)
R27	12 & 4 ch.	1kΩ (i)
R28	12 & 4 ch.	1kΩ (i)
R29	12 ch. only	1kΩ (i)
R30	12 ch. only	1kΩ (i)
R31	12 ch. only	1kΩ (i)
R32	12 ch. only	1kΩ (i)
R33	12 ch. only	1kΩ (i)
R34	12 ch. only	1kΩ (i)
R35	12 ch. only	1kΩ (i)
R36	12 ch. only	1kΩ (i)
R37	–all–	1·5kΩ (i)
R38	12 ch. only	1·5kΩ (i)
R39	12 ch. only	1·5kΩ (i)
R40	–all–	47Ω (i)
R41	12 ch. only	47Ω (i)
R42	12 ch. only	47Ω (i)
R43	12 & 4 ch.	100kΩ (i)
R44	12 & 4 ch.	100kΩ (i)
R45	12 & 4 ch.	100kΩ (i)
R46	12 & 4 ch.	100kΩ (i)
R47	12 ch. only	100kΩ (i)
R48	12 ch. only	100kΩ (i)
R49	12 ch. only	100kΩ (i)
R50	12 ch. only	100kΩ (i)
R51	12 ch. only	100kΩ (i)
R52	12 ch. only	100kΩ (i)
R53	12 ch. only	100kΩ (i)
R54	12 ch. only	100kΩ (i)
R55	–all–	47Ω (i)
R56	–all–	100Ω (i)
R57	–all–	6·8kΩ (i)
R58	–all–	3·3kΩ (i)
R59	–all–	120Ω (i)
R60	–all–	100Ω (i)
R61	–all–	33kΩ (i)
R62	–all–	100Ω (i)
R63	–all–	100Ω (i)
R64	–all–	6·8kΩ (i)
R65	–all–	3·3kΩ (i)
R66	–all–	100Ω (i)
R67	–all–	120Ω (ii)
R68	–all–	100Ω (i)
R69	–all–	33kΩ (ii)
R70	–all–	470Ω (i)
R71	–all–	100Ω (i)
R72	–all–	10kΩ (i)
R73	–all–	6·8kΩ (i)
R74	–all–	470Ω (i)
R75	–all–	10kΩ (i)
R76	–all–	470Ω (i)
R77	–all–	100Ω (i)
R78	–all–	15Ω (i)
R79	–all–	3·3kΩ (i)
R80	–all–	2·2kΩ (i)
R81	–all–	1kΩ (i)
R82	–all–	82Ω (i)
R83	–all–	82Ω (i)
R84	–all–	680Ω (i)
R85	–all–	33Ω (i)
R86	–all–	15Ω (i)
R87	–all–	100kΩ 0·2W LIN Potentiometer Piher PT10V
R88	–all–	6·8kΩ (i)
R89	–all–	5·6kΩ (i)
R90	–all–	4·7kΩ (i)
R91	–all–	1kΩ (i)
R92	–all–	1kΩ (i)
R93	–all–	22kΩ 0·2W LIN Potentiometer Piher PT10V
R94	–all–	2·2kΩ (i)
R95	–all–	100Ω (i)
R96	–all–	470Ω 0·2W LIN Potentiometer Piher PT10V
R97	–all–	22kΩ (i)
R98	–all–	47kΩ (i)
R99	–all–	2·2kΩ (i)
R100	–all–	22Ω (i)
R101	–all–	1·5kΩ (i)
R102	–all–	680Ω (i)
R103	–all–	1·5kΩ (i)
R104	–all–	330Ω (i)
R105	–all–	2·2MΩ ±10% (i)
R106	–all–	330Ω (i)
R107	–all–	10kΩ (i)
R108	–all–	8·2kΩ (ii)
R109	–all–	6·8kΩ (ii)
R110	–all–	22kΩ (i)
R111	–all–	3·3kΩ (i)
R112	–all–	220Ω (i)
R113	–all–	3·3kΩ (i)
R114	–all–	16kΩ (ii)
R115	–all–	20kΩ (ii)
R116	–all–	3·3kΩ (i)
R117	–all–	6·2kΩ (ii)
R118	–all–	6·2kΩ (ii)
R119	–all–	470Ω 0·2W LIN Potentiometer Piher PT10V
R120	–all–	1kΩ (ii)
R121	–all–	5·6kΩ (ii)
R122	–all–	2·2Ω (i)
R123	–all–	1kΩ (ii)
R124	–all–	680Ω (i)
R125	–all–	5·1kΩ (ii)
R126	–all–	1·5kΩ (i)
R127	–all–	1kΩ (i)
R128	–all–	330Ω (ii)
R129	–all–	120Ω (ii)
R130	–all–	3·3kΩ (ii)
R131	–all–	56Ω (ii)
R132	–all–	680Ω (i)
R133	–all–	100kΩ (i)
R134	–all–	22kΩ (i)
R135	–all–	2·2kΩ (i)
R136	–all–	2·2kΩ (i)
R137	–all–	2·2kΩ (i)
R138	–all–	3·3kΩ (i)
R139	–all–	3·3kΩ (i)
R140	–all–	3·3kΩ (i)
R141	–all–	3·3kΩ (i)
R142	–all–	2·2kΩ (i)
R143	–all–	2·2kΩ (i)
R144	–all–	2·2kΩ (i)
R145	–all–	3·3kΩ (i)
R146	–all–	680Ω (i)
R147	Not used	–
R148	–all–	100kΩ (i)
R149	–all–	1MΩ (i)
R150	–all–	2·2kΩ (i)
R151	–all–	4·7kΩ (i)
R152	–all–	180kΩ (i)
R153	–all–	180kΩ (i)
R154	–all–	180kΩ (i)
R155	–all–	100Ω ±10% 0·5W LIN Potentiometer Morganite 81E
R156	–all–	68Ω (i)

CAPACITORS

Commonly used capacitors are identified as follows:

(i)	10pF ±2% 63V Mullard C333CB
(ii)	0·001μF 500V Erie 831-K350081 Type 2
(iii)	0·01μF 250V Erie 801-K800011
(iv)	0·01μF ±20% 400V ITT PMT2R
(v)	2–18pF 300V Trimmer Mullard 809-05003
(vi)	2–22pF 250V Trimmer Mullard 808-11229

C1	–all–	0·01μF (iii)
C2	–all–	0·01μF (iii)
C3	–all–	0·01μF (iii)
C4	12 ch. only	0·01μF (iii)
C5	12 ch. only	0·01μF (iii)
C6	–all–	0·01μF (iii)
C7	12 ch. only	0·01μF (iii)
C8	12 ch. only	0·01μF (iii)
C9	–all–	Mid band 10pF (i) High band 2–22pF (vi)
C10 to C12	12 & 4 ch.	Mid band 10pF (i) High band 2–22pF (vi)
C13 to C20	12 ch. only	Mid band 10pF (i) High band 2–22pF (vi)
C21	–all–	2–22pF (vi)
C22	12 ch. only	2–22pF (vi)
C23	12 ch. only	2–22pF (vi)
C24	12 & 4 ch.*	0·01μF (iii)
C25	12 & 4 ch.	0·01μF (iii)
C26	12 & 4 ch.	0·01μF (iii)
C27	12 & 4 ch.	0·01μF (iii)
C28	12 ch. only	0·01μF (iii)
C29	12 ch. only	0·01μF (iii)
C30	12 ch. only	0·01μF (iii)
C31	12 ch. only	
C32	12 ch. only	
C33	12 ch. only	
C34	12 ch. only	
C35	12 ch. only	
C36	–all–	
C37	–all–	
C38	–all–	
C39	–all–	
C40	–all–	
C41	–all–	
C42	–all–	
C43	–all–	
C44	–all–	
C45	–all–	
C46	–all–	
C47	–all–	
C48	–all–	
C49	–all–	
C50	–all–	
C51	–all–	
C52	–all–	
C53	–all–	
C54	–all–	
C55	–all –	
C56	M/B only	
C57	–all–	
C58	–all–	
C59	–all–	
C60	–all–	
C61	–all–	
C62	–all–	
C63	–all–	
C64	–all–	
C65	–all–	
C66	–all–	
C67	–all–	
C68	–all–	
C69	–all–	
C70	Not used	
C71	–all–	
C72	M/B only	
C73	–all–	
C74	–all–	
C75	M/B only	
C76	–all–	
C77	–all–	
C78	–all–	
C79	–all–	
C80	–all–	
C81	–all–	
C82	–all–	
C83	–all–	
C84	–all–	
C85	–all–	
C86	–all–	
C87	–all–	
C88	–all–	
C89	–all–	
C90	–all–	
C91	–all–	
C92	–all–	
C93	–all–	
C94	–all–	
C95	–all–	
C96	–all–	
C97	–all–	
C98	–all–	

* In single channel versions, C24 is replaced by a wire link.

0·01μF (iii)
0·01μF (iii)
0·01μF (iii)
0·01μF (iii)
0·01μF (iii)

1μF ±20% 35V ITT TAG1M35
0·001μF (ii)
22pF ±5% 200V Erie YD-NPO
10μF ±20% 10V ITT TAG10M10
0·001μF (ii)

1μF ±20% 35V ITT TAG1M35
0·01μF (iii)
10μF ±20% 10V ITT TAG10M10
0·001μF (ii)
0·01μF (iii)

0·01μF (iii)
220pF ±2·5% 63V Suflex HS
0·001μF (ii)
330pF ±2·5% 63V Suflex HS
0·001μF (ii)

0·001μF (ii)
0·01μF (iii)
18pF ±10% 200V Erie YD-NPO
0·001μF (ii)
2–18pF (v)

10pF ±10% 200V Erie YD-NPO
0·001μF (ii)
0·001μF (ii)
12pF ±10% 200V Erie YD-NPO
2–18pF (v)

1·5pF ±0·1% 750V Lemco CT310S
0·001μF (ii)
2–18pF (v)
0·001μF (ii)
0·001μF (ii)

15pF ±10% 200V Erie YD-NPO
47pF ±5% 200V Erie YD-N750
0·001μF (ii)
Mid band 0·001μF (ii)
High band 4·7pF ±0·5pF 500V
Erie 861-NPO

–
2–18pF (v)
15pF ±10% 200V Erie YD-NPO
2–18pF (v)
2pF ±0·1% 750V Lemco CT310S
6·8pF ±10% 200V Erie YD-NPO

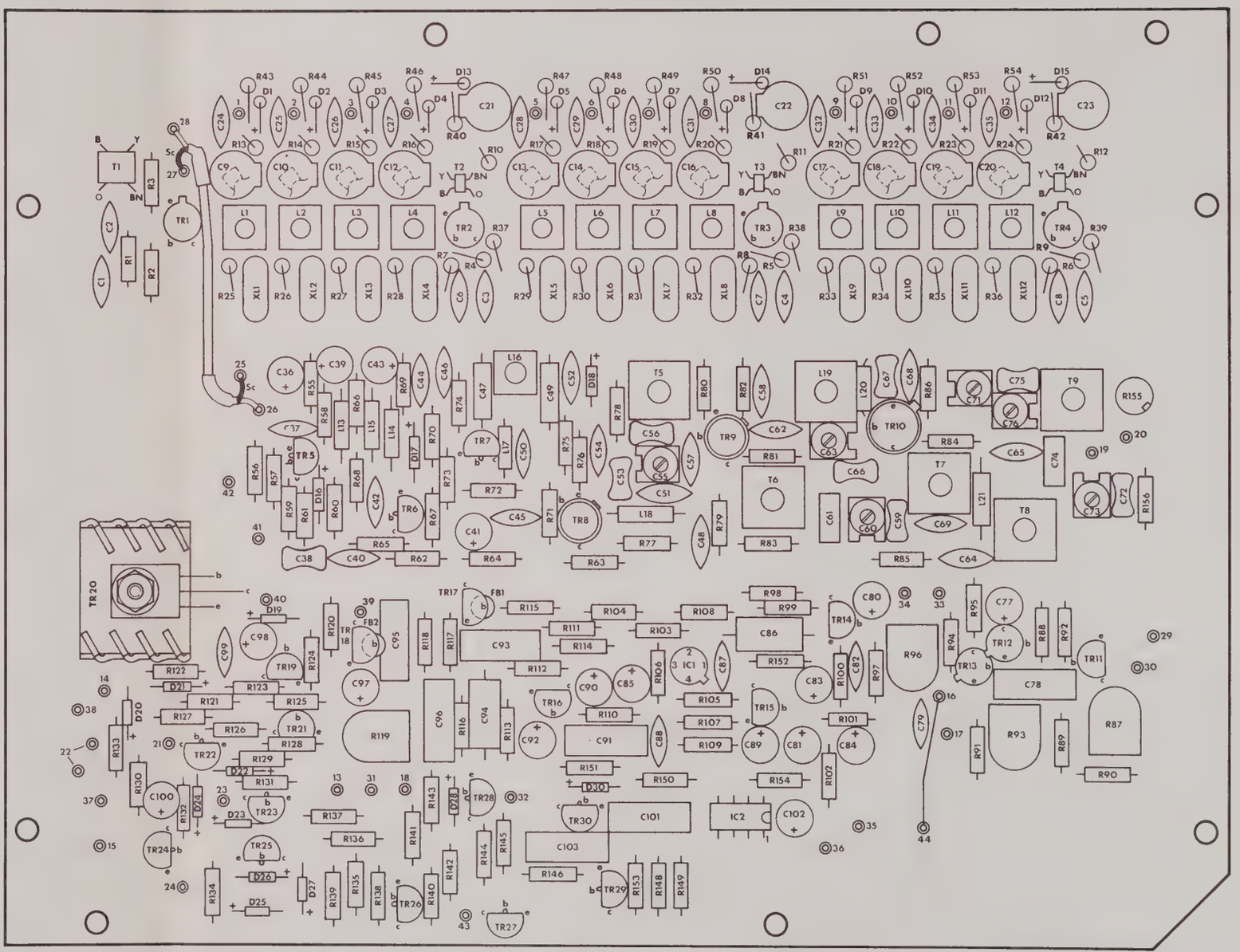
2–18pF (v)
33μF ±20% 16V ITT TAG33M16
0·01μF (iv)
0·01μF (iii)
1μF ±20% 35V ITT TAG1M35

33μF ±20% 10V ITT TAG33M10
0·001μF (ii)
4·7μF ±20% 16V ITT TAG4·7M16
33μF ±20% 10V ITT TAG33M10
33μF ±20% 10V ITT TAG33M10

0·0047μF ±2·5% 63V Suflex HS
0·001μF (ii)
0·01μF (iii)
100μF ±20% 3V ITT TAG100M3
33μF ±20% 10V ITT TAG33M10

0·22μF ±20% 100V ITT PMT2R
33μF ±20% 10V ITT TAG33M10
0·01μF (iv)
680pF ±2·5% 63V. Suflex HS
0·01μF (iv)

0·01μF (iv)
10μF ±20% 10V ITT TAG10M10
22μF ±20% 10V ITT TAG22M10



Drg. nos. are given in Table opposite

3

MID BAND/HIGH BAND TRANSMITTER PCB LAYOUT & COMPONENT LIST FIG.8.7(a)

Compt. List 8.7.1 contd.

C99	–all–	0·01μF (iii)
C100	–all–	22μF ±20% 10V ITT TAG22M10
C101	–all–	0·01μF (iv)
C102	–all–	100μF ±20% 10V ITT TAG100M10
C103	–all–	0·01μF (iv)

INDUCTORS

L1	–all–	Mid band L20007/3 Redifon High band L20010/3 Redifon
L2 to L4	12 & 4 ch.	Mid band L20007/3 Redifon High band L20010/3 Redifon
L5 to L12	12 ch. only	Mid band L20007/3 Redifon High band L20010/3 Redifon
L13	–all–	22μH Delevan 1025-52
L14	–all–	1·5μH Plessey 58/10/0006/10
L15	–all–	22μH Delevan 1025-52
L16	–all–	Mid band L20008/3 Redifon High band L20011/3 Redifon
L17	–all–	22μH Delevan 1025-52
L18	–all–	22μH Plessey 58/10/0013/10
L19	–all–	Mid band L10005/3 Redifon High band L10012/3 Redifon
L20	–all–	4·7μH Delevan 1025-36
L21	–all–	1μH Plessey 58/10/0005/10

TRANSFORMERS

T1	–all–	L30004/3 Redifon
T2	–all–	L30005/3 Redifon
T3	12 ch. only	L30005/3 Redifon
T4	12 ch. only	L30005/3 Redifon
T5	–all–	Mid band L20009/3 Redifon High band L20012/3 Redifon
T6	–all–	Mid band L10006/3 Redifon High band L10013/3 Redifon
T7	–all–	Mid band L10007/3 Redifon High band L10014/3 Redifon
T8	–all–	Mid band L10008/3 Redifon High band L10015/3 Redifon
T9	–all–	Mid band L10009/3 Redifon High band L10016/3 Redifon

FERRITE BEADS

FB1	–all–	FX1242 Mullard
FB2	–all–	FX1242 Mullard

DIODES

D1 to D4	12 & 4 ch.*	1N4148 ITT
D5 to D12	12 ch. only	1N4148 ITT
D13	12 & 4 ch.	1N4148 ITT
D14	12 ch. only	1N4148 ITT
D15	12 ch. only	1N4148 ITT
D16	–all–	HP5082-3080 Hewlett Packard
D17	–all–	HP5082-3080 Hewlett Packard
D18	–all–	1N4148 ITT
D19	–all–	Zener BZY88C5V1 Mullard
D20 to D28	–all–	1N4148 ITT
D29	Not used	–
D30	–all–	1N4148 ITT

* In single channel versions, D1 is replaced by a wire link.

TRANSISTORS

TR1	–all–	2N918 Texas or MPS918 Motorola
TR2	–all–	2N918 Texas
TR3	12 ch. only	2N918 Texas
TR4	12 ch. only	2N918 Texas
TR5	–all–	MPS918 Motorola or ZTX320 Ferranti
TR6	–all–	MPS918 Motorola or ZTX 320 Ferranti
TR7	–all–	MPS 918 Motorola or ZTX320 Ferranti
TR8	–all–	BSX19 Mullard
TR9	–all–	BSX19 Mullard
TR10	–all–	2N4427 RCA
TR11	–all–	BC212 Texas
TR12	–all–	BC173 or BC109 ITT
TR13	–all–	BC173 or BC109 ITT
TR14	–all–	BC173 or BC109 ITT
TR15	–all–	BC212 Texas
TR16	–all–	BC173 or BC109 ITT
TR17	–all–	BC173 or BC109 ITT
TR18	–all–	BC173 or BC109 ITT
TR19	–all–	BC171 ITT
TR20	–all–	MJE370 Motorola
TR21	–all–	BC171 ITT
TR22	–all–	2N4402 Motorola
TR23	–all–	2N4402 Motorola
TR24	–all–	2N5220 Motorola
TR25	–all–	2N5220 Motorola
TR26	–all–	2N4402 Motorola
TR27	–all–	2N4402 Motorola
TR28	–all–	2N5220 Motorola
TR29	–all–	2N5220 Motorola
TR30	–all–	2N5220 Motorola

INTEGRATED CIRCUITS

IC1	–all–	TAA263 Mullard
IC2	–all–	NE555V Signetics

CHANNEL CRYSTALS

XL1	–all–	Style J crystals to Redifon spec. P37288/S. Normally fitted to customer's order. For frequencies see chapter 7.
XL2 to XL4	12 & 4 ch.	
XL5 to XL12	12 ch.only	

3

Note to Fig.8.7(a)

12 channel PCB illustrated. In 4 channel and single channel versions, certain components associated with channel selection are not fitted–see Component List for details. PCB assembly drawing nos. for the various versions are given in the table below.

Band	*No. of channels*	*Equipment codes†*	*Transmitter PCB drawing no.*
Mid	12	C, D, E	001/11486B/1 Iss. 1
High	12	L, N, Q, S	001/11486E/1 Iss. 1
	4	K, M, P, R	001/11486D/1 Iss. 1
	1	J	001/11486C/1 Iss. 1

† For explanation of equipment codes, see Table 1.1 in chapter 1.

Notes to Fig.8.8(a)

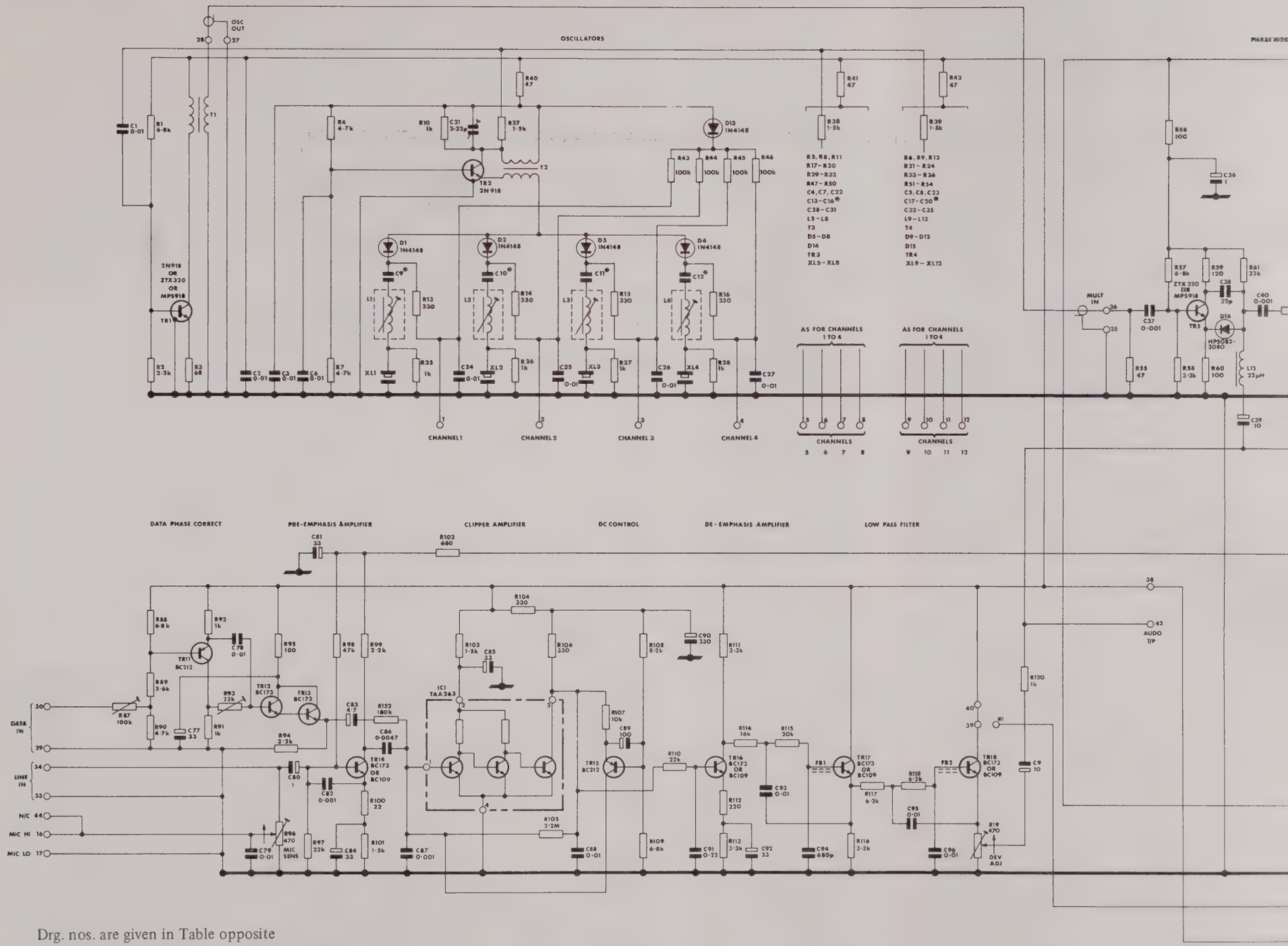
Circuit diagram shown for 12 channel PCB. In 4 channel and single channel versions, certain components associated with channel selection are not fitted—see Component List 8.7.1 for details. Circuit diagram drawing nos. for the various versions are given below.

Band	*No. of channels*	*Equipment codes†*	*Circuit diagram drawing no.*
Mid	12	C, D, E	002/11486B/X Iss. 2
High	12	L, N, Q, S	002/11486E/X Iss. 2
	4	K, M, P, R	002/11486D/X Iss. 2
	1	J	002/11486C/X Iss. 2

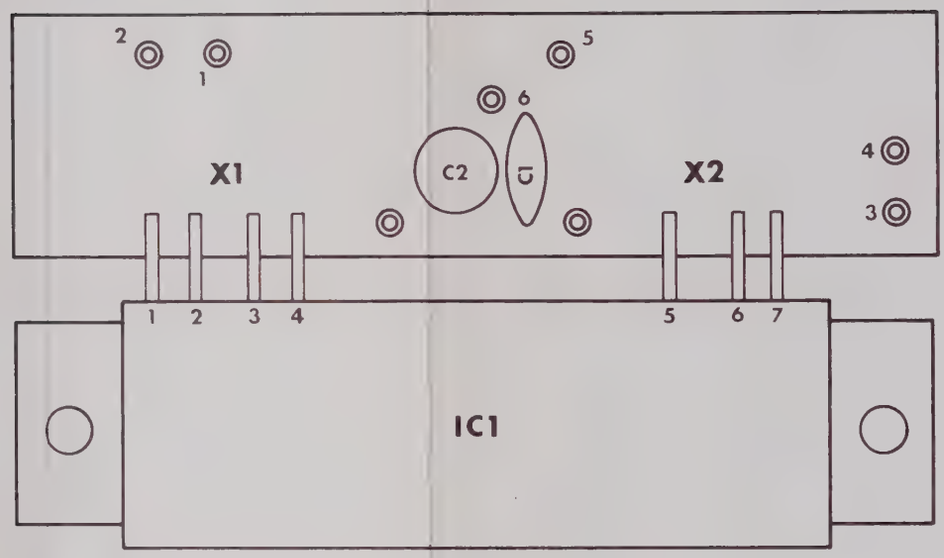
† For explanation of equipment codes, see Table 1.1 in chapter 1.

* Components which differ between mid band and high band versions are as follows:

	Mid band	*High band*
C9–C20	10pF fixed	2–22pF trimmer
C56	10pF	not fitted
C69	0·001μF	4·7pF
C72	15pF	not fitted
C75	6·8pF	not fitted



Drg. nos. are given in Table opposite



010/11483A/3 Iss. 1

Fig.8.9(a) Power Amplifier Assembly Layout

4

8.9.1 Power Amplifier Component List

CAPACITORS

C1 0·01μF 250V Erie 801-K800011
C2 10μF ±20% 25V ITT TAG10M25

MICROSTRIP TRANSMISSION LINES

X1, X2 } formed in copper track on PCB

INTEGRATED CIRCUIT

IC1 Low band: BGY32 Mullard*
Mid band: BGY33 Mullard*
High band: BGY36 Mullard*

* Early equipments fitted with 438BGY, 438BGY/H & 437BGY/A respectively.

8.9.2 Antenna Filter Component List

CAPACITORS

Unless otherwise stated, all capacitors are ±2% 63V Mullard C333CB or CC

C1 Low band
Mid band 15pF (CB)
High band 8·2pF (CB)

C2 Low band
Mid band 27pF (CC)
High band 18pF (CB)

C3 Low band
Mid band 27pF (CC)
High band 18pF (CB)

C4 Low band
Mid band 27pF (CC)
High band 18pF (CB)

C5 Low band
Mid band 15pF (CB)
High band 8·2pF (CB)

C6 0·001μF 500V Leadthrough Erie 361-K26
C7 0·001μF 500V Erie 831-K350081 Type 2

INDUCTORS

L1–L4 Single assembly to drg:
Low band
Mid band L10010/3 Redifon
High band L10025/3 Redifon
L5 4·7μH Plessey 58/10/0009/10

SOCKET

SK1 50Ω BNC Greenpar GE35006G

8.9.3 Antenna Switch Component List

NOTE The antenna switch circuit is fitted only in single antenna equipments.

CAPACITOR

C1 0·001μF 500V Erie 831-K350081 Type 2

DIODES

D1 BA243 ITT
D2 BA243 ITT

CRITICAL LENGTH COAXIAL LINES

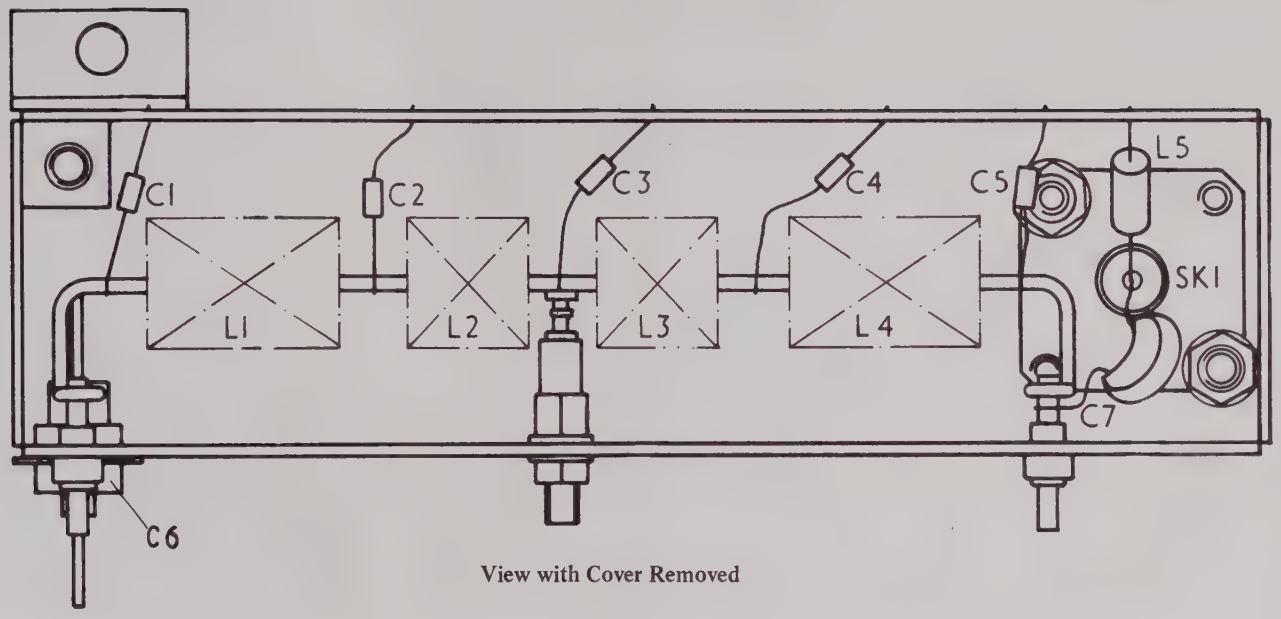
Cable is 50Ω BICC type T3264
All cable lengths are ±4·7mm (±3/16 in)

X1: PA output to antenna filter
Low band 70mm (2 3/4 in)
Mid band 381 mm (15 in)
High band 127mm (5 in)

X2: antenna filter to diode terminal block
Low band 616mm (24 1/4 in)
Mid band 381 mm (15 in)
High band 330mm (13 in)

DIODE TERMINAL BLOCK

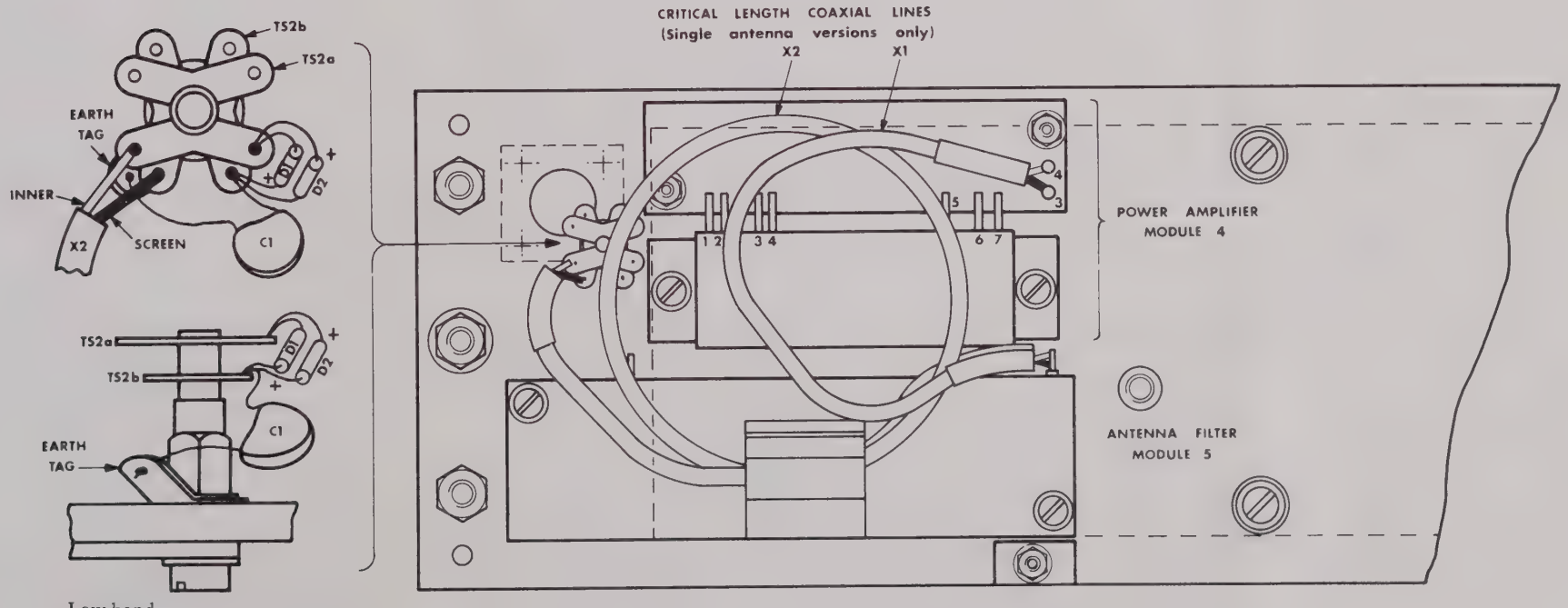
TS2a,b Jackson 5125 (2-tier stand-off insulator)



View with Cover Removed

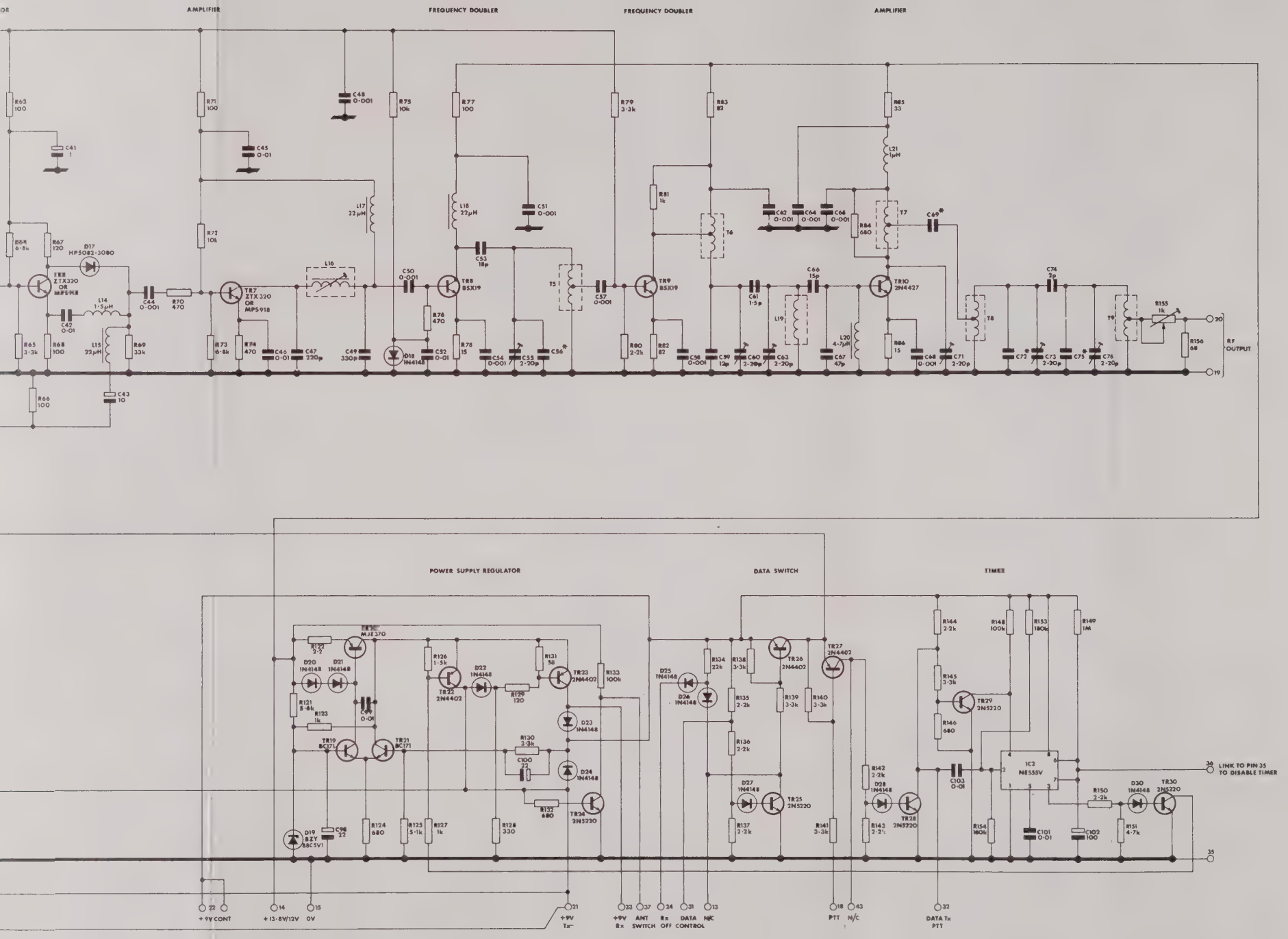
Low band
Mid band 001/11484A/2 Iss. 1
High band 001/11484B/2 Iss. 1

Fig.8.9(b) Antenna Filter Layout



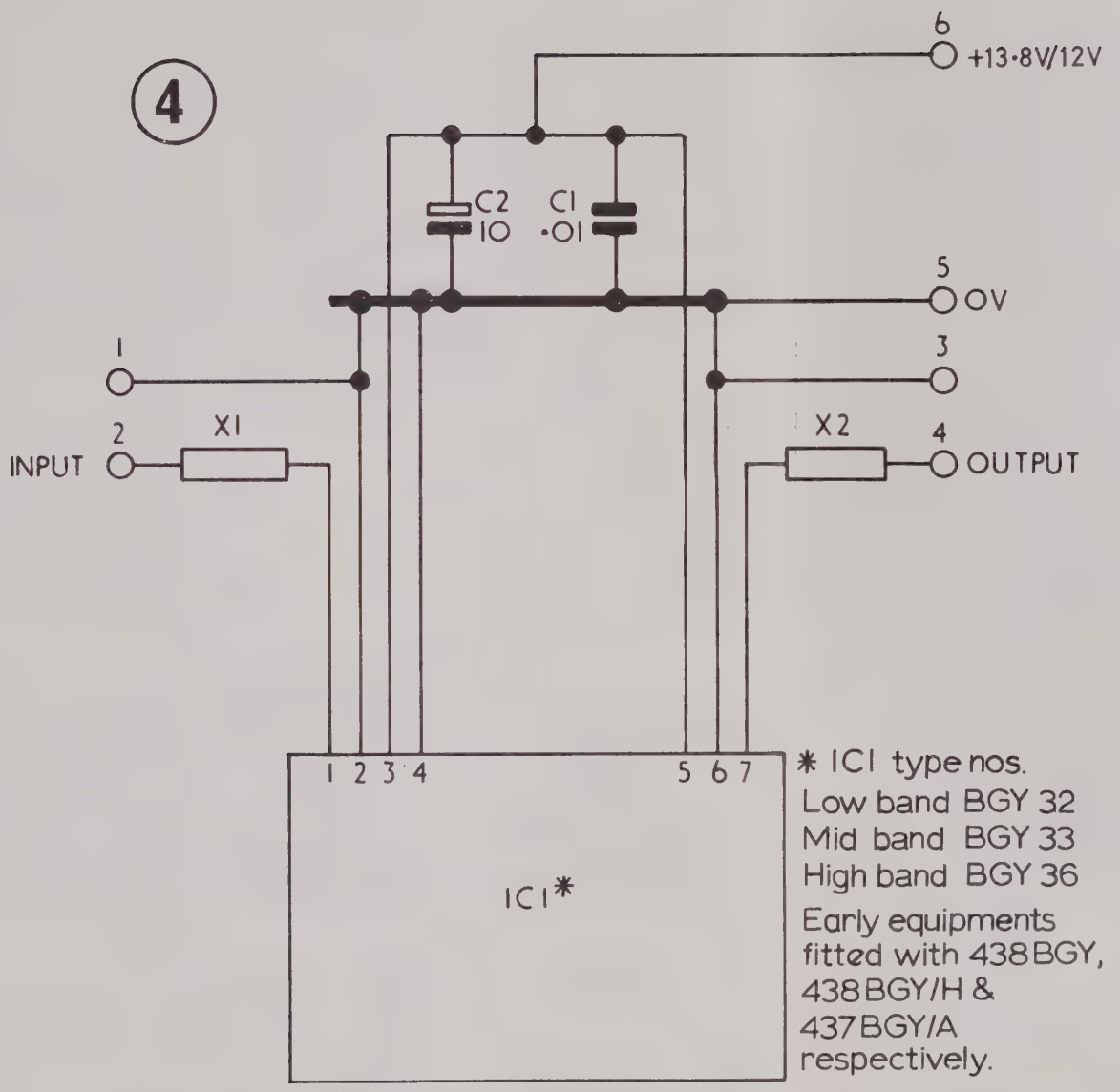
Low band
Mid band 001/11483B/1 Iss.1
High band 001/11483C/1 Iss.1

Fig.8.9(c) PA & Antenna Filter Assembly Layout



3

MID BAND/HIGH BAND TRANSMITTER PCB CIRCUIT FIG.8.8(a)



Low band
Mid band 002/11483B/S Iss. 1
High band 002/11483C/S Iss. 1

Fig.8.10(a) Power Amplifier Circuit

8.11.1 Mid Band/High Band Receiver PCB Component List

NOTE All components are prefixed as shown below to indicate in which versions of the equipment they are fitted:

–all–:	fitted in 12 channel, 4 channel & single channel versions
12 & 4 ch:	fitted in 12 channel & 4 channel versions
12 ch. only:	fitted in 12 channel versions only.

RESISTORS

Commonly used resistors are identified as follows:

(i) ±5% 0·33W Mullard CR25
(ii) ±2% 0·25W Electrosil TR4

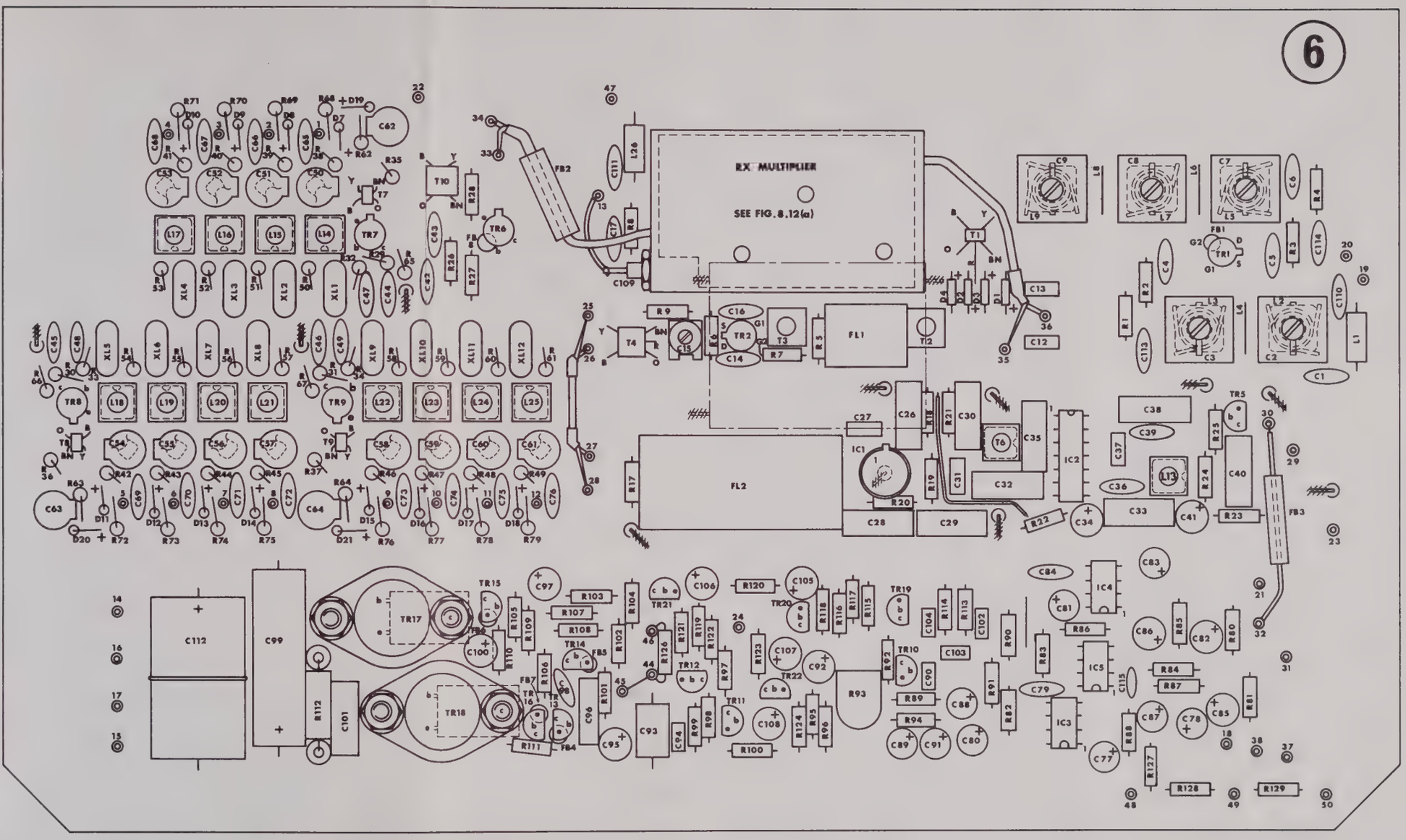
R1	–all–	22kΩ (i)
R2	–all–	22kΩ (i)
R3	–all–	150Ω (i)
R4	–all–	100Ω (i)
R5	–all–	5·6kΩ (ii)
R6	–all–	22kΩ (i)
R7	–all–	22kΩ (i)
R8	–all–	100Ω (i)
R9	–all–	150Ω (i)
R10 to R16	see Component List 8.11.2	
R17	–all–	1·2kΩ (i)
R18	–all–	47Ω (i)
R19	–all–	1kΩ (i)
R20	–all–	2·2kΩ (i)
R21	–all–	100Ω (i)
R22	–all–	100Ω (i)
R23	–all–	27kΩ (i)
R24	–all–	1Ω (i)
R25	–all–	1kΩ (i)
R26	–all–	6·8kΩ (i)
R27	–all–	2·2kΩ (i)
R28	–all–	Mid band 270Ω (i) High band 150Ω (i)
R29	–all–	4·7kΩ (i)
R30	12 ch. only	4·7kΩ (i)
R31	12 ch. only	4·7kΩ (i)
R32	–all–	4·7kΩ (i)
R33	12 ch. only	4·7kΩ (i)
R34	12 ch. only	4·7kΩ (i)
R35	–all–	1kΩ (i)
R36	12 ch. only	1kΩ (i)
R37	12 ch. only	1kΩ (i)
R38	–all–	330Ω (i)
R39	12 & 4 ch.	330Ω (i)
R40	12 & 4 ch.	330Ω (i)
R41	12 & 4 ch.	330Ω (i)
R42	12 ch. only	330Ω (i)
R43	12 ch. only	330Ω (i)
R44	12 ch. only	330Ω (i)
R45	12 ch. only	330Ω (i)
R46	12 ch. only	330Ω (i)
R47	12 ch. only	330Ω (i)
R48	12 ch. only	330Ω (i)
R49	12 ch. only	330Ω (i)
R50	–all–	1kΩ (i)
R51	12 & 4 ch.	1kΩ (i)
R52	12 & 4 ch.	1kΩ (i)
R53	12 & 4 ch.	1kΩ (i)
R54	12 ch. only	1kΩ (i)
R55	12 ch. only	1kΩ (i)
R56	12 ch. only	1kΩ (i)
R57	12 ch. only	1kΩ (i)
R58	12 ch. only	1kΩ (i)
R59	12 ch. only	1kΩ (i)
R60	12 ch. only	1kΩ (i)
R61	12 ch. only	1kΩ (i)
R62	–all–	47Ω (i)
R63	12 ch. only	47Ω (i)
R64	12 ch. only	47Ω (i)
R65	–all–	1·5kΩ (i)
R66	12 ch. only	1·5kΩ (i)
R67	12 ch. only	1·5kΩ (i)
R68	12 & 4 ch.	100kΩ (i)
R69	12 & 4 ch.	100kΩ (i)
R70	12 & 4 ch.	100kΩ (i)
R71	12 & 4 ch.	100kΩ (i)
R72	12 ch. only	100kΩ (i)
R73	12 ch. only	100kΩ (i)
R74	12 ch. only	100kΩ (i)
R75	12 ch. only	100kΩ (i)
R76	12 ch. only	100kΩ (i)
R77	12 ch. only	100kΩ (i)
R78	12 ch. only	100kΩ (i)
R79	12 ch. only	100kΩ (i)
R80	–all–	3·3kΩ (i)
R81	–all–	1kΩ (i)
R82	–all–	100Ω (i)
R83	–all–	100Ω (i)
R84	–all–	47kΩ (i)
R85	–all–	10kΩ (i)
R86	–all–	10kΩ (i)
R87	–all–	1MΩ (i)
R88	–all–	1Ω (i)
R89	–all–	68kΩ (i)
R90	–all–	33kΩ (i)
R91	–all–	15kΩ (i)
R92	–all–	2·2kΩ (i)
R93	–all–	4·7kΩ 0·2W LIN Potentiometer Piher PT10V
R94	–all–	4·7kΩ (i)
R95	–all–	68kΩ (ii)
R96	–all–	12kΩ (ii)
R97	–all–	5·1kΩ (ii)
R98	–all–	24kΩ (ii)
R99	–all–	18kΩ (ii)
R100	–all–	680Ω (ii)
R101	–all–	4·7kΩ (ii)
R102	–all–	1kΩ (i)
R103	–all–	680Ω (ii)
R104	–all–	27kΩ (ii)
R105	–all–	5·6kΩ (ii)
R106	–all–	2·2kΩ (i)
R107	–all–	2kΩ (ii) if TR17, TR18 are BD106A 1·8kΩ (ii) if 2N5295 or TIP31 fitted
R108	–all–	1kΩ (ii)
R109	–all–	220Ω (i)
R110	–all–	1kΩ (i)
R111	–all–	1kΩ (i)
R112	–all–	1Ω ±5% 1·5W CGS type CG3
R113	–all–	8·2kΩ (ii)
R114	–all–	8·2kΩ (ii)
R115	–all–	22kΩ (ii)
R116	–all–	39kΩ (ii)
R117	–all–	4·7kΩ (i)
R118	–all–	22kΩ (ii)
R119	–all–	6·8kΩ (ii)
R120	–all–	330Ω (ii)
R121	–all–	22kΩ (i)
R122	–all–	470Ω (i)
R123	–all–	1kΩ (i)
R124	–all–	4·7kΩ (ii)
R125	Not used	
R126	–all–	4·7kΩ (i)
R127	–all–	1·5kΩ (i)
R128	–all–	1·5kΩ (i)
R129	–all–	6·8kΩ (i)

CAPACITORS

Commonly used capacitors are identified as follows:

(i) 10pF ±2% 63V Mullard C333CB
(ii) 0·001μF 500V Erie 831-K350081 Type 2
(iii) 0·0018μF ±10% 30V Erie 8121A-100-K120071
(iv) 0·01μF 250V Erie 801-K800011
(v) 0·1μF ±20% 100V ITT PMT2R
(vi) 2–22pF Trimmer 250V Mullard 808-11229

C1	–all–	0·001μF (ii)
C2	–all–	2–10pF Trimmer 013/11487A/4 Redifon
C3	–all–	2–10pF Trimmer 013/11487A/4 Redifon
C4	–all–	0·001μF (ii)
C5	–all–	0·001μF (ii)
C6	–all–	0·001μF (ii)
C7	–all–	2–10pF Trimmer 013/11487A/4 Redifon
C8	–all–	2–10pF Trimmer 013/11487A/4 Redifon
C9	–all–	2–10pF Trimmer 013/11487A/4 Redifon
C10	Not used	–
C11	Not used	–
C12	–all–	68pF ±2% 63V Mullard C333CH
C13	–all–	68pF ±2% 63V Mullard C333CH
C14	–all–	0·01μF (iv)
C15	–all–	2–18pF Trimmer Mullard 809-05003
C16	–all–	0·01μF (iv)
C17	–all–	0·01μF (iv)
C18 to C25	see Component List 8.11.2	
C26	–all–	0·1μF (v)
C27	–all–	68pF ±2% 63V Mullard C333CH
C28	–all–	0·1μF (v)
C29	–all–	0·1μF (v)
C30	–all–	0·1μF (v)
C31	–all–	100pF ±2% 63V mullard C333CC
C32	–all–	0·1μF (v)
C33	–all–	0·1μF (v)
C34	–all–	15μF ±20% 10V ITT TAG15M10
C35	–all–	0·1μF (v)
C36	–all–	4·7pF ±0·5pF 500V Erie 861-NPO
C37	–all–	120pF ±2% 63V Mullard C333CC
C38	–all–	0·1μF (v)
C39	–all–	68pF ±2% 63V Mullard C333CC
C40	–all–	0·1μF (v)
C41	–all–	0·47μF ±20% 35V ITT TAG0·47M35
C42	–all–	0·01μF (iv)
C43	–all–	0·01μF (iv)
C44	–all–	0·01μF (iv)
C45	12 ch. only	0·01μF (iv)
C46	12 ch. only	0·01μF (iv)
C47	–all–	0·01μF (iv)
C48	12 ch. only	0·01μF (iv)
C49	12 ch. only	0·01μF (iv)
C50	–all–	Mid band 10pF (i) High band 2–22pF (vi)
C51	12 & 4 ch.	Mid band 10pF (i) High band 2–22pF (vi)
C52	12 & 4 ch.	Mid band 10pF (i) High band 2–22pF (vi)
C53	12 & 4 ch.	Mid band 10pF (i) High band 2–22pF (vi)
C54	12 ch. only	Mid band 10pF (i) High band 2–22pF (vi)
C55	12 ch. only	Mid band 10pF (i) High band 2–22pF (vi)
C56	12 ch. only	Mid band 10pF (i) High band 2–22pF (vi)
C57	12 ch. only	Mid band 10pF (i) High band 2–22pF (vi)
C58	12 ch. only	Mid band 10pF (i) High band 2–22pF (vi)
C59	12 ch. only	Mid band 10pF (i) High band 2–22pF (vi)
C60	12 ch. only	Mid band 10pF (i) High band 2–22pF (vi)



Drg. nos. are given in Table opposite

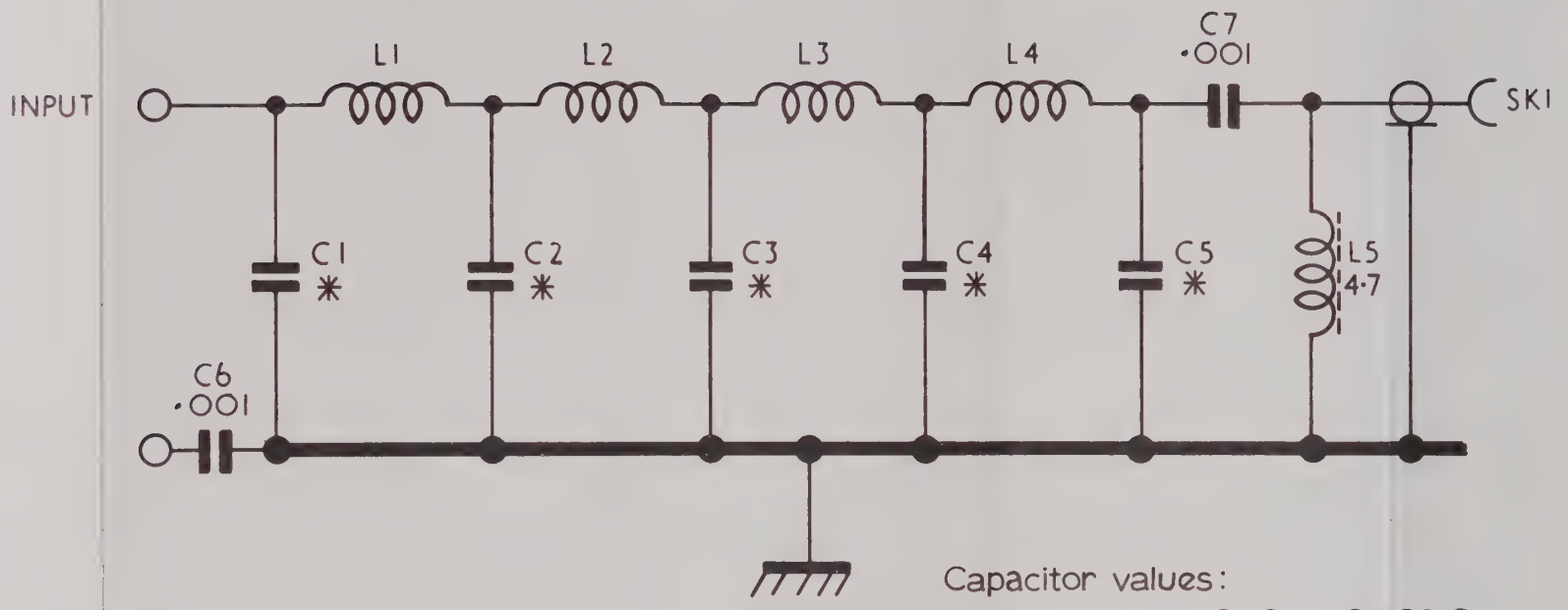
C61	12 ch. only	Mid band 10pF (i) High band 2–22pF (vi)
C62	–all–	2–22pF (vi)
C63	12 ch. only	2–22pF (vi)
C64	12 ch. only	2–22pF (vi)
C65	12 & 4 ch.*	0·01μF (iv)
C66	12 & 4 ch.	0·01μF (iv)
C67	12 & 4 ch.	0·01μF (iv)
C68	12 & 4 ch.	0·01μF (iv)
C69	12 ch. only	0·01μF (iv)
C70	12 ch. only	0·01μF (iv)
C71	12 ch. only	0·01μF (iv)
C72	12 ch. only	0·01μF (iv)
C73	12 ch. only	0·01μF (iv)
C74	12 ch. only	0·01μF (iv)
C75	12 ch. only	0·01μF (iv)

* In single channel versions, C65 is replaced by a wire link.

C76	12 ch. only	0·01μF (iv)
C77	–all–	1μF ±20% 35V ITT TAG1M35
C78	–all–	1μF ±20% 35V ITT TAG1M35
C79	–all–	0·001μF (ii)
C80	–all–	100μF ±20% 10V ITT TAG100M10
C81	–all–	100μF ±20% 10V ITT TAG100M10
C82	–all–	1μF ±20% 35V ITT TAG1M35
C83	–all–	1μF ±20% 35V ITT TAG1M35
C84	–all–	0·001μF (ii)
C85	–all–	1μF ±20% 35V ITT TAG1M35
C86	–all–	47μF ±20% 16V ITT TAG47M16
C87	–all–	22μF ±20% 16V ITT TAG22M16
C88	–all–	0·47μF ±20% 35V ITT TAG0·47M35
C89	–all–	15μF ±20% 10V ITT TAG15M10
C90	–all–	0·0018μF (iii)
C91	–all–	4·7μF ±20% 16V ITT TAG4·7M16
C92	–all–	0·1μF ±20% 35V ITT TAG0·1M35

C93	–all–	0·0047μF ±2·5% 63V Suflex HS
C94	–all–	0·0018μF (iii)
C95	–all–	0·1μF ±20% 35V ITT TAG0·1M35
C96	–all–	0·01μF ±20% 100V ITT PMT2R
C97	–all–	47μF ±20% 3V ITT TAG47M3
C98	–all–	130pF 500V Erie 861-K120051
C99	–all–	220μF 25V Mullard 017-16221
C100	–all–	4·7μF ±20% 35V ITT TAG4·7M35
C101	–all–	0·1μF (v)
C102	–all–	0·0018μF (iii)
C103	–all–	0·0018μF (iii)
C104	–all–	0·0018μF (iii)
C105	–all–	0·1μF ±20% 35V ITT TAG0·1M35
C106	–all–	0·1μF ±20% 35V ITT TAG0·1M35
C107	–all–	100μF ±20% 3V ITT TAG100M3
C108	–all–	47μF ±20% 16V ITT TAG47M16
C109	–all–	0·001μF 500V Leadthrough Erie 361-K2600
C110	–all–	0·001μF (ii)

MID BAND/HIGH BAND RECEIVER PCB LAYOUT & COMPONENT LIST FIG.8.11(a)



Low band
Mid band 002/11484A/S Iss. 1
High band 002/11484B/S Iss. 1

Fig.8.10(b) Antenna Filter Circuit

Compt. List 8.11.1 contd.

C111	–all–	0·01μF (iv)
C112	–all–	1000μF 25V Mullard 017-16102
C113	–all–	0·01μF (iv)
C114	–all–	0·01μF (iv)
C115	–all–	0·001μF ±10% 100V Mullard 630-02102

INDUCTORS

L1	–all–	1μH Plessey 58/10/0005/10
L2	–all–	Mid band L10011/3 Redifon
		High band L10017/3 Redifon
L3	–all–	Mid band L10002/3 Redifon
		High band L10018/3 Redifon
L4	–all–	32 swg wire link
L5	–all–	Mid band L10003/3 Redifon
		High band L10018/3 Redifon
L6	–all–	32 swg wire link
L7	–all–	Mid band L10004/3 Redifon
		High band L10019/3 Redifon
L8	–all–	32 swg wire link
L9	–all–	Mid band L10001/3 Redifon
		High band L10017/3 Redifon
L10 to L12	see Component List 8.11.2	
L13	–all–	L20003/3 Redifon
L14	–all–	L20004/3 Redifon
L15	12 & 4 ch.	L20004/3 Redifon
L16	12 & 4 ch.	L20004/3 Redifon
L17	12 & 4 ch.	L20004/3 Redifon
L18 to L25	12 ch. only	L20004/3 Redifon
L26	–all–	33μH Plessey 58/10/0014/10

TRANSFORMERS

T1	–all–	L30001/3 Redifon
T2	–all–	10A-02 Toyo
T3	–all–	10A-02 Toyo
T4	–all–	L30002/3 Redifon
T5	see Component List 8.11.2	
T6	–all–	L20006/3 Redifon
T7	–all–	L30003/3 Redifon
T8	12 ch. only	L30003/3 Redifon
T9	12 ch. only	L30003/3 Redifon
T10	–all–	L30004/3 Redifon

FERRITE BEADS

FB1	–all–	FX1242 Mullard
FB2	–all–	B62110-A6021-X001 Siemens
FB3	–all–	B62110-A6021-X001 Siemens
FB4 to FB8	–all–	FX1242 Mullard

FILTERS

FL1	–all–	10M-2A Toyo
FL2	12·5kHz*	024DC ITT
	25kHz*	024BC ITT

* Minimum channel spacing

DIODES

D1 to D4	–all–	MS5110 Solitron or HP5082-2835 Hewlett Packard
D5 D6	see Component List 8.11.2	
D7 to D10	12 & 4 ch.*	1N4148 ITT
D11 to D18	12 ch. only	1N4148 ITT
D19	12 & 4 ch.	1N4148 ITT
D20	12 ch. only	1N4148 ITT
D21	12 ch. only	1N4148 ITT

* In single channel versions, D7 is replaced by a wire link.

TRANSISTORS

TR1	–all–	BFS28 Mullard
TR2	–all–	BFS28 Mullard
TR3 TR4	see Component List 8.11.2	
TR5	–all–	BC214 Texas
TR6	–all–	2N918 Texas or MPS 918 Motorola
TR7	–all–	2N918 Texas
TR8	12 ch. only	2N918 Texas
TR9	12 ch. only	2N918 Texas
TR10	–all–	BC184 Texas
TR11	–all–	BC184 Texas
TR12	–all–	BC184 Texas
TR13	–all–	BC171 ITT
TR14	–all–	BC171 ITT
TR15	–all–	BC171 ITT
TR16	–all–	BC212 Texas
TR17 & TR18	–all–	BD106A ITT, 2N5295 RCA or TIP31 Texas
TR19	–all–	BC184 Texas
TR20	–all–	BC171 ITT
TR21	–all–	BC212 Texas
TR22	–all–	BC171 ITT

INTEGRATED CIRCUITS

IC1	–all–	CA3028 RCA
IC2	–all–	ULN2111A Sprague
IC3	–all–	MC3340P Motorola
IC4	–all–	MC3340P Motorola
IC5	–all–	MC1741CP1 Motorola

CHANNEL CRYSTALS

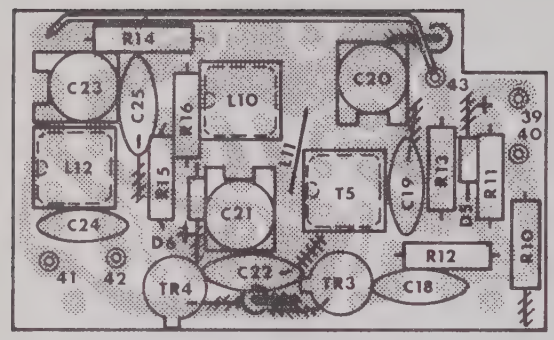
XL1	–all–	Style J crystals to Redifon spec. P37288/S. Normally fitted to customer's order. For frequencies see chapter 7.
XL2 to XL4	12 & 4 ch.	
XL5 to XL12	12 ch.only	

Note to Fig. 8.11 (a)

12 channel PCB illustrated. In 4 channel and single channel versions, certain components associated with channel selection are not fitted–see Component List for details. PCB assembly drawing nos. for the various versions are given in the table below.

Band	*No. of channels*	*Channel spacing*	*Equipment codes†*	*Receiver PCB drawing no.*
Mid	12	12·5kHz	C, D, E	001/11487B/1 Iss. 1
High	12	12·5kHz	L, N	001/11487E/1 Iss. 1
		25kHz	Q, S	001/11487G/1 Iss. 1
	4	12·5kHz	K, M	001/11487D/1 Iss. 1
		25kHz	P, R	001/11487F/1 Iss. 1
	1	–	J	001/11487C/1 Iss. 1

† For explanation of equipment codes, see Table 1.1 in chapter 1.



Mid Band 011/11487A/2 Iss.1
High Band 011/11487B/2 Iss.1

Fig.8.12(a) Mid Band/High Band Rx Multiplier PCB Layout

8.12.1 Mid Band/High Band Rx Multiplier PCB Component List

RESISTORS
All resistors are ±5% 0·33W Mullard CR25

R10	100Ω
R11	6·8kΩ
R12	2·2kΩ
R13	100Ω
R14	100Ω
R15	2·2kΩ
R16	6·8kΩ

CAPACITORS

C18	0·01μF 250V Erie 801-K800011
C19	0·01μF 250V Erie 801-K800011
C20	1·8–10pF 500V Trimmer Mullard 809-05002
C21	1·8–10pF 500V Trimmer Mullard 809-05002
C22	32pF ±5% 500V Erie 801-N075
C23	2–18pF 500V Trimmer Mullard 809-05003
C24	0·001μF 500V Erie 831-K350081 Type 2
C25	0·01μF 250V Erie 801-K800011

INDUCTORS

L10	Mid band L20001/3 Redifon High band L20014/3 Redifon
L11	32 swg wire link
L12	L20002/3 Redifon

TRANSFORMER

T5	Mid band L20005/3 Redifon High band L20015/3 Redifon

DIODES

D5	1N4148 ITT
D6	1N4148 ITT

TRANSISTORS

TR3	2N2368 Motorola
TR4	2N2368 Motorola

Notes to Fig.8.13(a)

Circuit diagram shown for 12 channel PCB. In 4 channel and single channel versions, certain components associated with channel selection are not fitted–see Component List 8.11.1 for details. Circuit diagram drawing nos. for the various versions are given below.

Band	*No. of channels*	*Equipment codes†*	*Circuit diagram drawing no.*
Mid	12	C, D, E	002/11487B/X Iss. 3
High	12	L, N, Q, S	002/11487E & G/X Iss. 3
	4	K, M, P, R	002/11487D & F/X Iss. 3
	1	J	002/11487C/X Iss. 3

† For explanation of equipment codes, see Table 1.1 in chapter 1.

* Components which differ between mid band and high band versions are as follows:

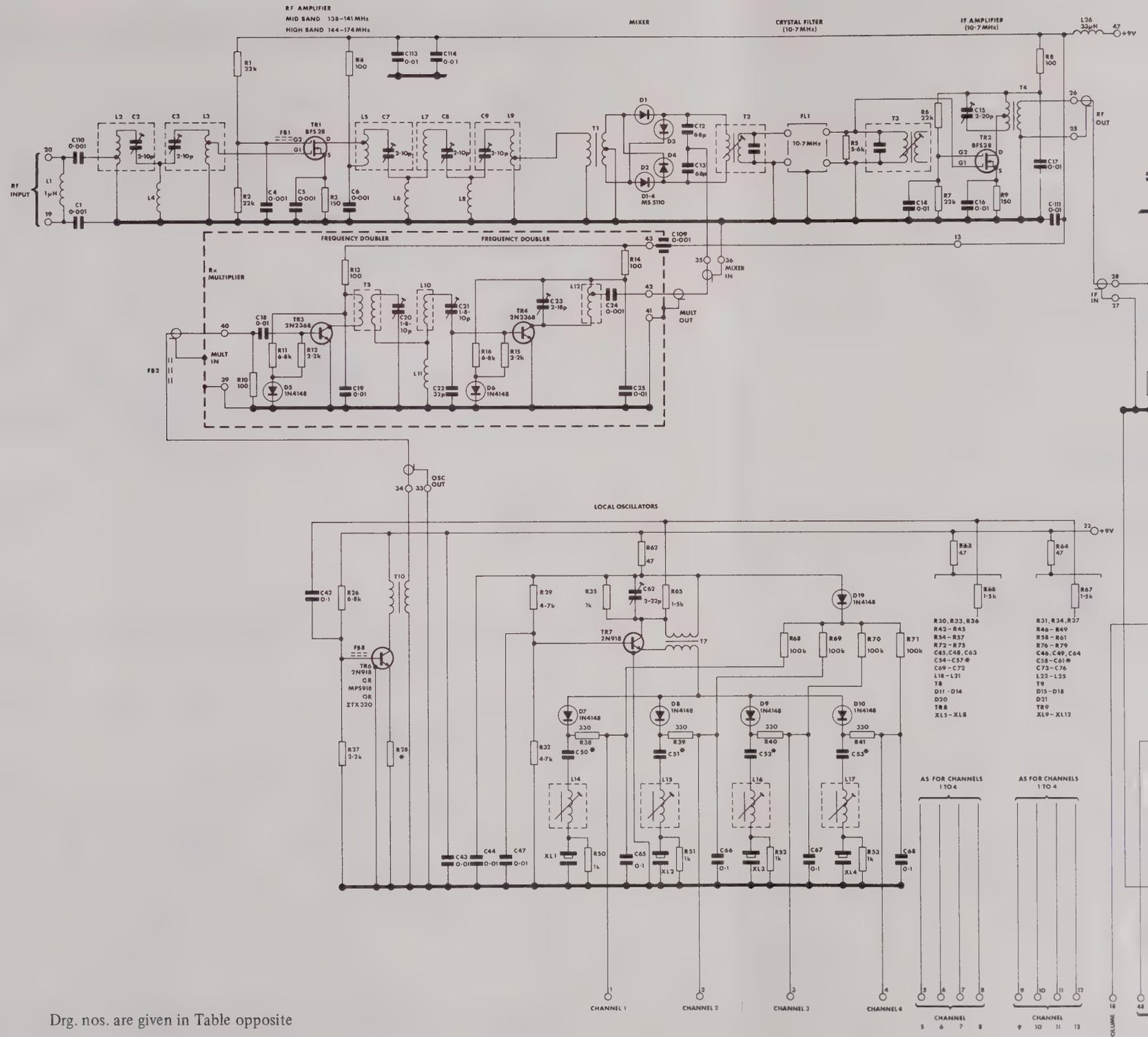
	Mid band	*High band*
R28	270Ω	150Ω
C50–C61	10pF fixed	2–22pF trimmer

† R107 value depends on TR17, TR18 transistors fitted

TR17, TR18	*R107*
BD106A	2kΩ
2N5295	1·8kΩ
TIP31	1·8kΩ

6

MID BAND/HIGH BAND Rx MULTIPLIER PCB LAYOUT & COMPONENT LIST



Drg. nos. are given in Table opposite

8.14.1

RESISTO

R1 (Volur

R2 (Squel

R3

DIODES

D1
D2

SWITCHE

S1 (Chann
S2 (On/of

LAMP

LP1

TERMINA

TS1

MICROPH
(Standard

P37886/3

FLYING L

PL1

Optional M

PL2 (Mic)

SK1 (PTT)

NOTE

tended Control Unit Component List

50kΩ 1W LIN Potentiometer
Allen-Bradley 70A1N042F503M
50kΩ 1W LOG Potentiometer
Allen-Bradley 70A1N042F503R
kΩ ±5% 0·33W Mullard CR25

Z15 Mullard
D 586-475 (Red) Radiospares

201/11636A/3 Redifon
1602-22B Arrow

', 40mA LES, Vitality 687

TRIP

/11636A/3 Redifon

E/PTT SWITCH ASSEMBLY

lifon, attached to control unit by captive cable.

D CONNECTOR(S)

way plug 74/10/3502/10 Plessey

PTT connectors:

Pin housing 151679/6 (Blue) AMP
Pins 163558-2 (2 off) AMP

Socket housing 151680/2 (Red) AMP
Sockets 163557-2 (2 off) AMP

ing connectors for the Mic/PTT connectors
itted) are as follows:
: Socket housing 151680/6 (Blue) AMP
Sockets 163557-2 (2 off) AMP
': Pin housing 151679/2 (Red) AMP
Pins 163558-2 (2 off) AMP

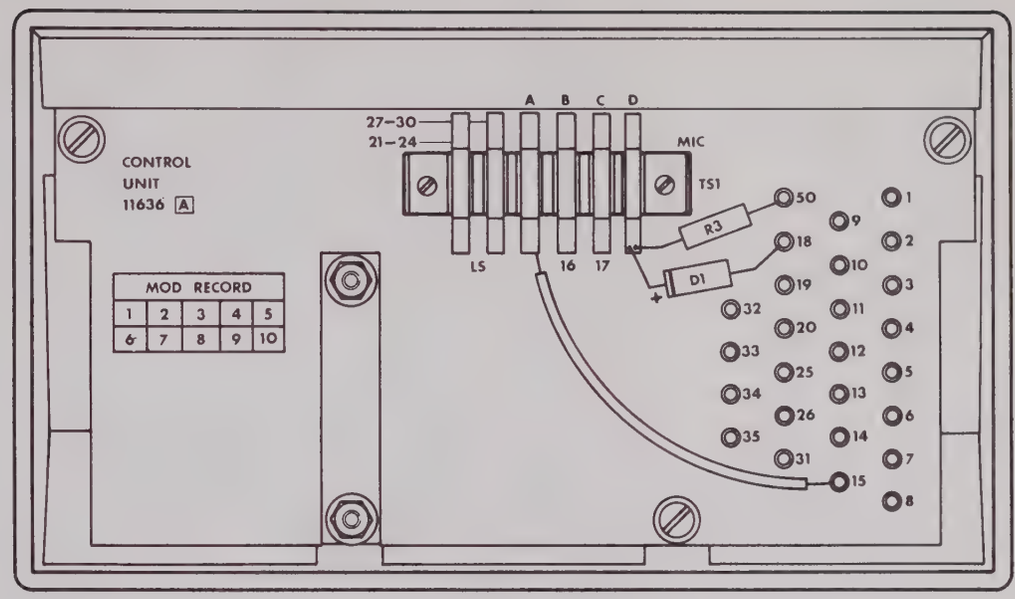
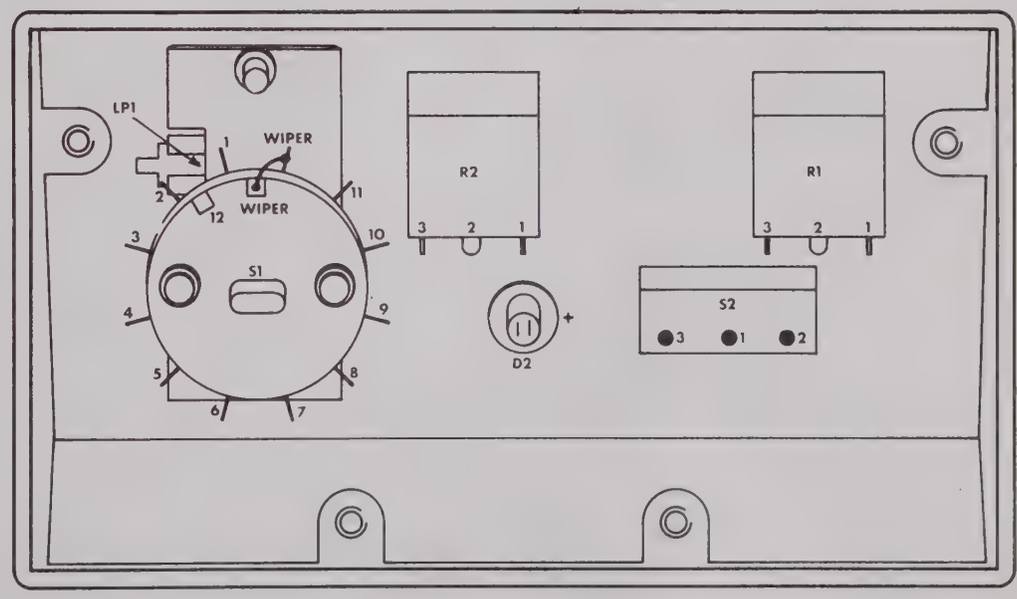


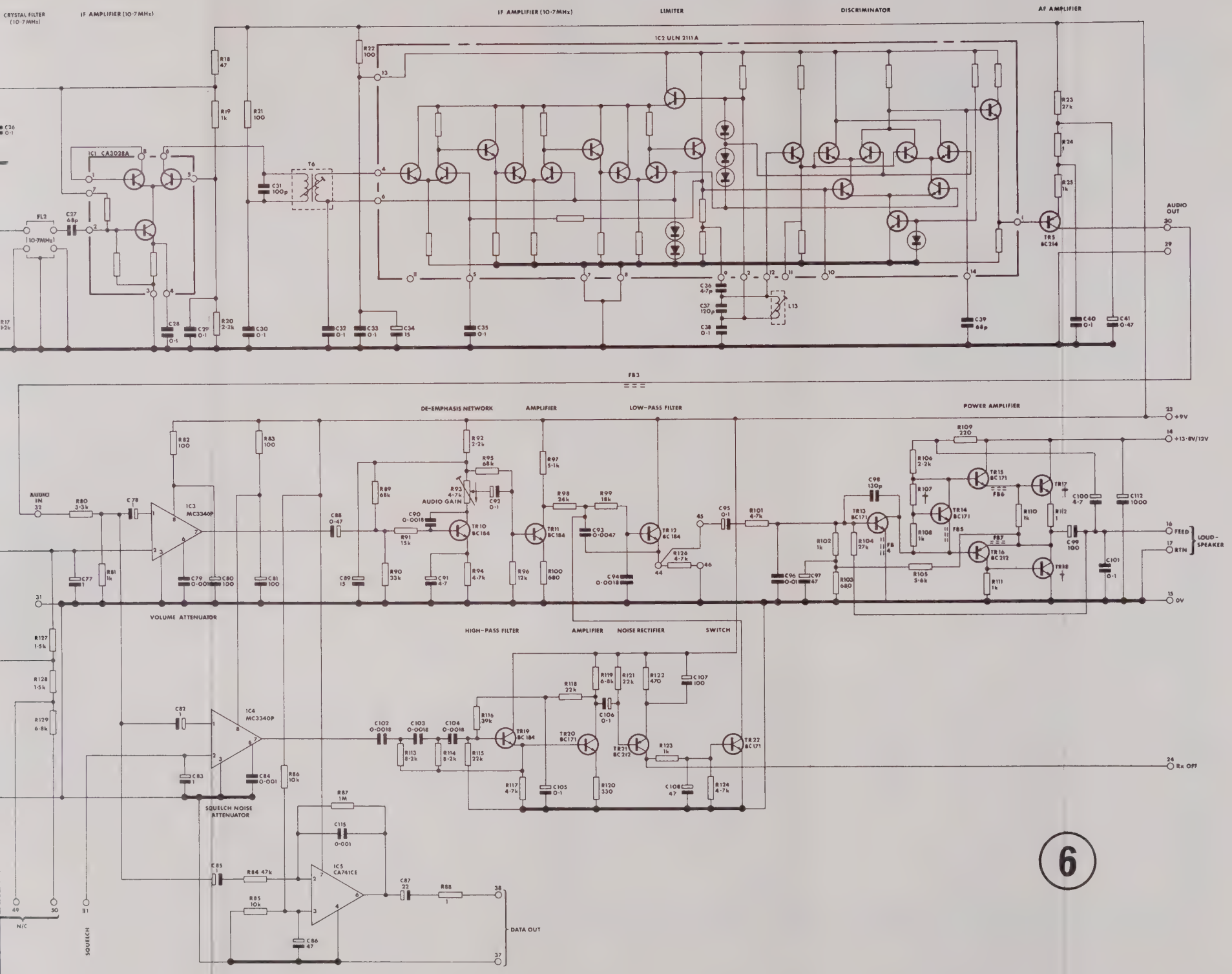
Fig.8.14(a) Rear View with Cover Removed

7



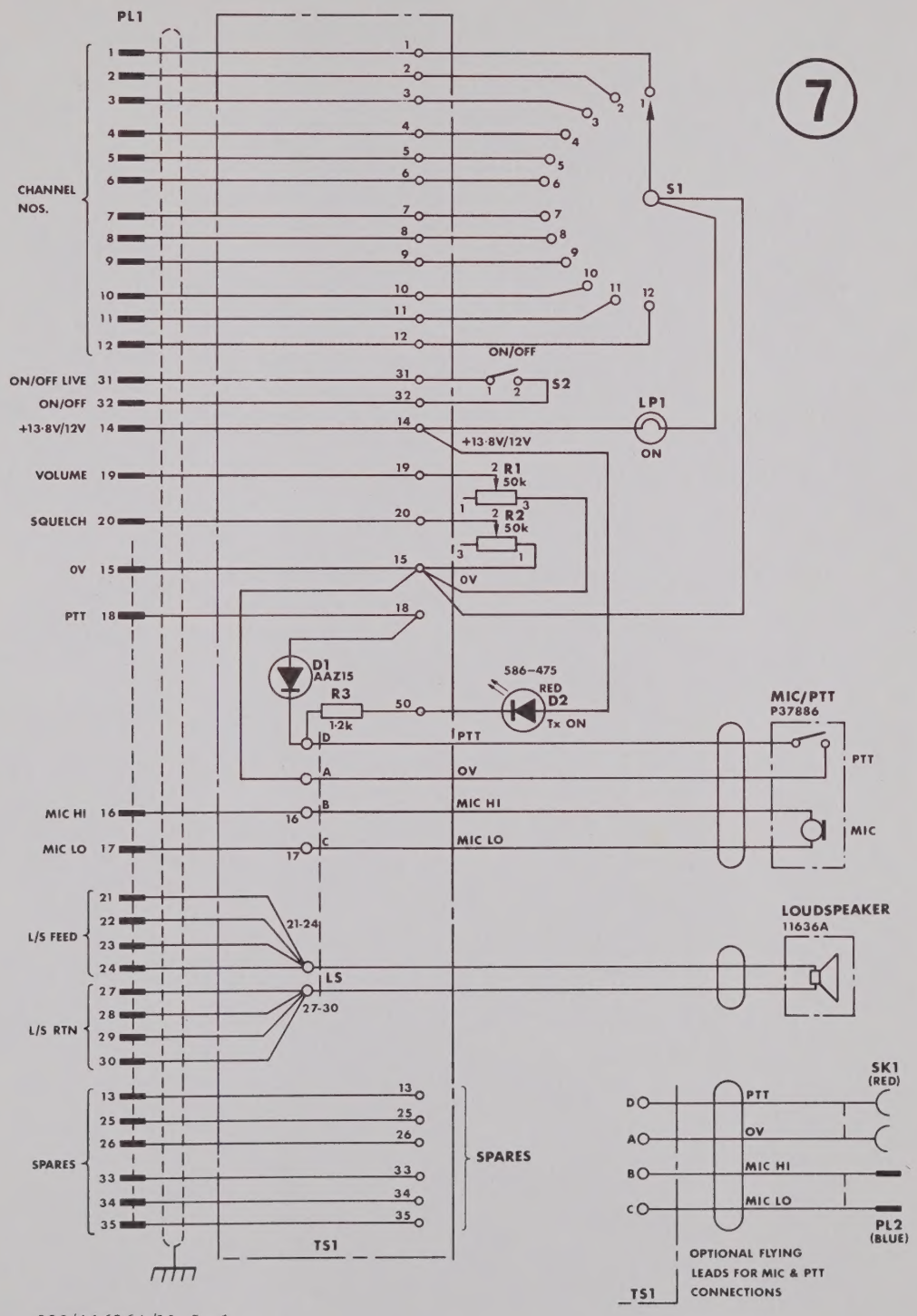
Nos. SHOWN ARE CHANNEL Nos. AND CORRESPOND TO PIN Nos.

Fig.8.14(b) View with Terminal Panel Removed



6

MID BAND/HIGH BAND RECEIVER CIRCUIT FIG.8.13(a)



002/11636A/M Iss.1

EXTENDED CONTROL UNIT CIRCUIT

MP MASTER
MA23860